FLIGHT and The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH

Chief Photographer
JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

8-10, CORPORATION ST., COVENTRY. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.
GUILDHALL BUILDINGS, NAVIGATION ST., BIRMINGHAM, 2. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).
260, DEANSGATE, MANCHESTER, 3. Telegrams: Iliffe, Manchester. Telephone: Blackfriars 4412.
26B, RENFIELD ST., GLASGOW, C.2. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

SUBSCRIPTION RATES: Home and Abroad: Year, £3 1 0. 6 months, £1 10 6. 3 months, 15s. 3d.
Registered at the G.P.O. as a Newspaper.

No. 1720. Vol. XL. DECEMBER 11th, 1941. Thursdays, One Shilling.

The Outlook

Aircraft in the Libyan Battle

AS news comes in from the Middle East it becomes more possible to estimate the part played by aircraft in this unique battle in the desert. It is certainly not accurate to describe this battle as a repetition of the Battle of France with rôles reversed. In France the enemy had a superior number of fighters in the air and also an overwhelming superiority of armoured forces on the ground. It was not a battle of tank versus tank. Consequently, the Ju 87 Stukas had things pretty much their own way, and gained a reputation which they scarcely deserved. In the conditions which prevailed almost any type of bomber could have done what the Stukas did.

In the fighting round Sidi Rezegh the Empire has a fighter superiority in the air, which makes it possible for our bombers to do their proper work. Some disappointment has been expressed that the latter have not won the battle by knocking out the German tanks. A well-placed bomb will put a tank out of action, but with tanks manœuvring rapidly it is very hard to score a bullseye with a bomb. The alternative at the disposal of the aircraft is the shell-gun. Shells from the 20 mm. gun have destroyed quite a number of the lighter German tanks, and in this work the Beaufighter has played a notable part, but such shells will not pierce the thickest armour of the heavy class of German tanks. The latter only succumb to the fire of other heavy tanks or of artillery.

The Empire aircraft have accordingly concentrated on another way of helping our ground troops. A tank without fuel is as useless as a tank which has been holed by a shell, and fighting men need food and water, ammunition, and many other things. The R.A.F. and its Empire colleagues have concentrated on reducing the supplies which the Germans receive. Lorries and tankers have been destroyed in great numbers, while the bombing raids on the ports of embarkation in Italy and Sicily, as well as on the ports of arrival in Libya, contribute materially to the same object. The Navy, with its Air Arm and the other air forces, are combining wholeheartedly in finding and sinking supply ships on their way to Africa, and this, too, is all part of the same good work. Our superiority in fighters makes this work possible, at least round the battlefield, for on fighter superiority everything else hangs.

It seems that the enemy must be relying largely on stores accumulated in Africa before the British attack started. They, too, are being bombed, and in any case they cannot last for ever.

Post-war Plans

IT is comforting to know that Mr. Hildred, the new Director-General of Civil Aviation, is not merely sitting in his office and waiting for the war to end. What his own ideas are for the development of air transport after the war has not yet been made public, but others are setting their brains to work and are submitting plans to him. In our issue of November 6th we published a memorandum presented by North-Eastern Airways, Limited, which considered the problem. Since then Mr. Walter Runciman, Director-General of British Overseas Airways, has told the people of Durban that the Corporation has plans under consideration for

bringing Great Britain and South Africa within 30 hours' flying time of each other. These plans may not yet have taken a very concrete form, but the statement is distinctly cheering. It is further evidence that active brains are already at work, and that their ideas are big. Details can be arranged later, and nobody can foretell the limits to which the powers of aircraft may have developed by the time the guns cease fire.

The flights of successive Liberator machines show that the Atlantic is fast shrinking, not in geographical size but in what matters, the time which it takes to cross it. In Victorian slang that ocean was often referred to as the "herring pond," and now the term is better justified. American Export Airlines are pressing for leave to introduce some competition into services across the Atlantic, and that, too, promises an increase of speed.

When all this plan-making activity is going on, it was not to be expected that the British Airways Corporation should lag behind. It is desirable—in fact, it is a necessity—that the Empire air routes should be speeded up in a way not contemplated before the war. The journeys and conferences of General Wavell, for example, have demonstrated how important speedy air communications are for purposes of defence. When peace returns the need for keeping all parts of the British Empire, so to speak, cheek by jowl, will be no whit less urgent.

It is significant that the Corporation is obtaining from America some Curtiss-Wright C-W20s. These are substratosphere aircraft with pressure cabins, and are the largest twin-engined landplanes in commercial service.

And Now Japan

EVER since the incident when Japanese sentries at Shanghai stripped British subjects and slapped the faces of British women, the Empire of Nippon has been growing more and more hostile to the British Empire. Positions are reversed from what they were in the early years of this century when Japan was at war with Russia, and Britain was the Ally of Japan. In those days all Britons rejoiced at the great Japanese naval victory of Tsushima over the Russian Baltic Fleet, and were proud to recall that Admiral Togo had once been a cadet in the training ship, H.M.S. *Worcester*, at Greenhithe.

The British-trained Togo was a good Admiral, but the Russian fleet of those days was but a feeble force. On the sea, and in the air, Japan has never been matched against a first-class Western Power. The experience of bombing undefended Chinese cities which the aircraft of the Japanese Army has accumulated in the last few years will not be of much value when those same aircraft encounter British, American, and (it may well be) Russian fighters. But at first the contest is bound to be between naval forces and their own air arms. In this sphere Japan has formidable numbers on her side, but she has no useful experience of fighting. She may say that the same is true of the American Navy and its air arm. It cannot be said of the British naval and air Services; and we British, knowing the stuff of which Americans are made, have no doubts about the fight which they will wage.

NO SIGNS OF PANIC: The deck of H.M.S. *Ark Royal* shortly before she sank. Members of the crew are going about their business calmly, in spite of the list which will soon send the few remaining aircraft sliding into the sea.

War in the Air

NEARING THE END : A destroyer going alongside H.M.S. *Ark Royal* to take off survivors.

November Records : Malta as a Base of Aggression : German Futility in the West

NOVEMBER was not a good month for night flying, and the activities of Bomber Command were accordingly circumscribed. There were, in fact, fifteen nights in the month on which it was impossible to raid Germany or occupied territory. On the other nights our bombers did what they could to atone for this by their efforts, and as a result the total bombing effort of this November was 40 per cent. greater than that of November, 1940. Of course, such a result does not satisfy the ambitions of Air Chief Marshal Pierce and his Groups, but it is really remarkable that in the circumstances the results were so good as they were. Much of the credit goes to the new heavy bombers.

One is rather apt to think of Malta as a fortress which defends itself rather than as a centre of aggression against the enemy. As a useful corrective to this frame of mind, an official statement has been issued on the island, which states that bombers operating from Malta during November dropped over 1,000,000 bombs on enemy targets. Heavy bombers flew 250,000 miles to reach their targets, which included Naples, Brindisi, Messina, Tripoli, Benghazi, and other African ports. Thus they provided powerful support for our land forces in Libya.

Medium bombers are stated to have played a great part in harrying and sinking enemy shipping, while naval aircraft successfully bombed Sicilian airfields, besides attacking convoys.

Twenty-three enemy aircraft were destroyed over and around Malta during the month. One thousand and nine air-raid alarms have been sounded in Malta since the beginning of the war.

From other sources it is learnt that the island is now very well provided with shelters, and cave colonies have been dug out of the limestone, equipped with all modern conveniences. The Maltese take warnings very philosophically, but a raid by enemy fighters brings them out into the open, confident that the R.A.F. will deal with the matter adequately, and they want to see all they can of the fight.

There are now two meatless days a week in Malta, but otherwise food is plentiful, and temporary shops are springing up among the ruins in the bombed areas.

For many reasons the German raids on Great Britain during November and the early part of December have all been very light in character, and nearly all carried out by night. Though the daylight sweeps over France by Fighter Command have kept a large proportion of the best German fighters in the west, thereby helping the Russians materially, it appears that the bombers stationed on the French airfields and near-by are mostly manned by raw crews who are

LAST GLIMPSE OF A GALLANT SHIP : Picture taken from a Catalina flying boat of the *Ark Royal* just before she took the final plunge.

WAR IN THE AIR

learning their business by flying to the British coasts by night and dropping a few bombs without running more risk than they must. Only experienced crews would be expected to cope with the defences of the most important areas, and these have been avoided. Nevertheless, few nights pass without our night fighters bringing down one or two out of the small number of raiders who come over, which means a substantial percentage of loss, and cannot be at all encouraging for the tyro crews.

One German bomber recently flew about over the west country until it got thoroughly lost, and when it decided to turn back its navigator mistook the Bristol Channel for the English Channel. South of the water it saw a lighted landing ground, and followed another machine down. It did not realise that its guide was a British machine coming home, but the men on the ground recognised their visitor, and an armoured car followed it as it taxied along, and when the crew emerged they were surrounded by guards armed with Tommy guns and other weapons, and were all taken prisoners. An experienced crew would hardly have made that mistake.

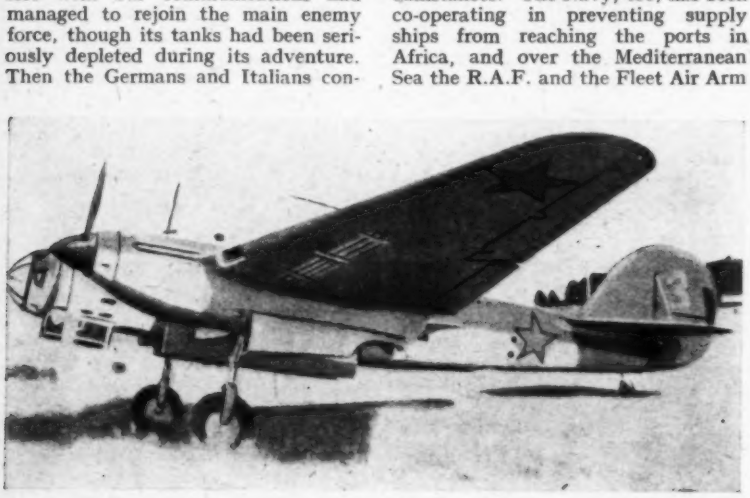
In Libya

THE weather in the Western Desert last week was very bad, with driving rain and cold on the coast and a sandstorm inland. This, added to the inevitable fatigue of both sides and the need for running repairs to the various vehicles, brought active operations to a standstill for a while. The remnants of the small German force which had broken out to the east in an endeavour to interfere with our communications had managed to rejoin the main enemy force, though its tanks had been seriously depleted during its adventure. Then the Germans and Italians concentrated their forces and broke through the corridor along the coast which had been established by the New Zealanders who had advanced from the east joining hands with the garrison which had sallied out from Tobruk. Then came the lull while both sides reorganised for fresh encounters.

The latest Russian fighter, according to German sources. The I-18, also known as the I-200, has a liquid-cooled AM35A engine of 1,200 h.p. Armament comprises two heavy and two light machine guns.

The bad weather did not, however, entirely prevent our aircraft from carrying on their attacks on the enemy supply lines and airfields. Many direct hits were made on concentrations of motor transport, and that sort of activity is about the best contribution which the R.A.F. can make to the Army's struggle, at least in present circumstances. The Navy, too, has been co-operating in preventing supply ships from reaching the ports in Africa, and over the Mediterranean Sea the R.A.F. and the Fleet Air Arm work cordially together. The latter has some advantage in being able to use the torpedo, and as yet no report has come in of R.A.F. torpedo-aircraft being used in the Mediterranean. That class of machine has been very useful off the coasts of Norway and Holland.

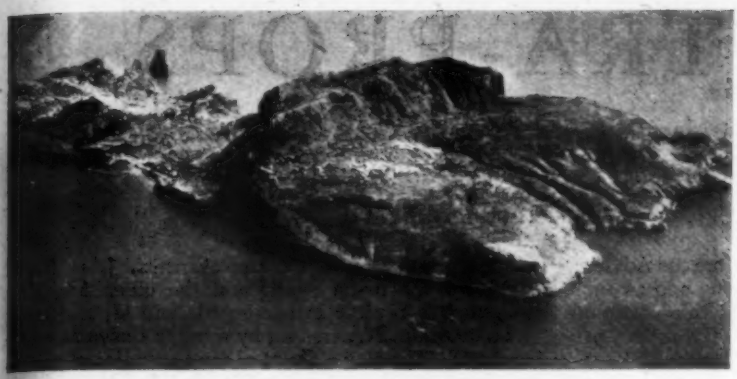
In Libya the Ju 88 has lately appeared in fighter guise, and it would certainly be quite useful in interfering with our medium bombers, though it would be outmatched by the Hurricane, the Beaufighter, and the Tomahawk. However, the majority of the Axis fighters in Libya appear to be Italians. The Blenheims press home their attacks whatever the opposition, and the Empire fighters have an undoubted superiority in numbers as well as in quality over the opposition. Consequently, many an enemy petrol tanker gets holed by the bullets of our machine guns, and the precious petrol pours out on to the sand. Bombs overturn lorries and other vehicles, and cannon fire from the air will penetrate the armour of the lighter enemy tanks. The heavy tanks are a problem for our own heavy tanks and our artillery.



Soviet medium bomber type SB-RK is a development of the SB-3. The engines are liquid-cooled M 105's of 1,100 h.p. Note the diving brakes under the wings.

Catapult Seaplanes

TURNING for a moment to the South Atlantic, a recent incident has shown once again how useful it is for cruisers to carry catapult seaplanes. On November 22nd the dawn aircraft reconnaissance from H.M.S. *Devonshire*, on patrol in the South Atlantic, sighted a merchant vessel stopped. The cruiser closed at full speed and flew off an aircraft for a more detailed examination. The general appearance of the ship indicated a similarity to one of the German armed



A GOOD LANDMARK: The Isle of Capri, in the Bay of Naples, is a sight familiar to many of our bomber crews from recent raids.

merchant raiders. The replies made to H.M.S. *Devonshire's* signals were unsatisfactory, and fire was, therefore, opened. The enemy ship endeavoured to escape behind a smoke screen, but in ten minutes was on fire and the crew abandoned ship into their boats. The magazine exploded and the vessel sank. A few days later H.M.S. *Dorsetshire* (which finally sank the *Bismarck*) gained a similar success, thanks to her aircraft reconnaissance.

The lull in the desert battle came to an end after the necessary interval for reorganisation, and furious fighting was resumed. All reports from the Army authorities in the Middle East pay glowing tributes to the work of the Empire Air Forces, and the reports which come in of supply columns attacked and wrecked are most encouraging.

War with Japan

SINCE our last issue four more countries have been added to the number of our formal enemies: Finland, Hungary, Rumania, and (above all) Japan.

There would be little use in mentioning the first reports of fighting between Japan and the United States which are coming in as we go to press. By the time these lines are in the hands of our readers more definite information will be available. It is a curious situation, when the United States and Britain are allied against Japan, but the Americans are not formally at war with the other opponents of Britain and Russia.

Japan's war against the two great English-speaking democracies is bound to be, at least in the early stages, mainly a naval war. The word naval includes the air arms of the three navies engaged. Carriers must be the protagonists on the Japanese side, and they have obviously struck the first blows by bombing the American islands in the Pacific. Carriers can only exist if other warships protect them, and so sea and air tactics go together. We may refer our readers to the issues of *Flight* of January 9th, 1941, which contained an article on the aircraft carriers of the Japanese Navy, and of February 27th, which dealt with Japan's air strength in general. One important point to note is that, though Japanese aircraft, mainly belonging to the Army, have been active in China for some years, their air crews have never had to face such formidable air powers as the British Empire and the United States. The surprise attack with which Japan started the war gave her an advantage, but that will not last. We may all contemplate such an air contest with confidence.

ENEMY AIR LOSSES TO DEC. 6th

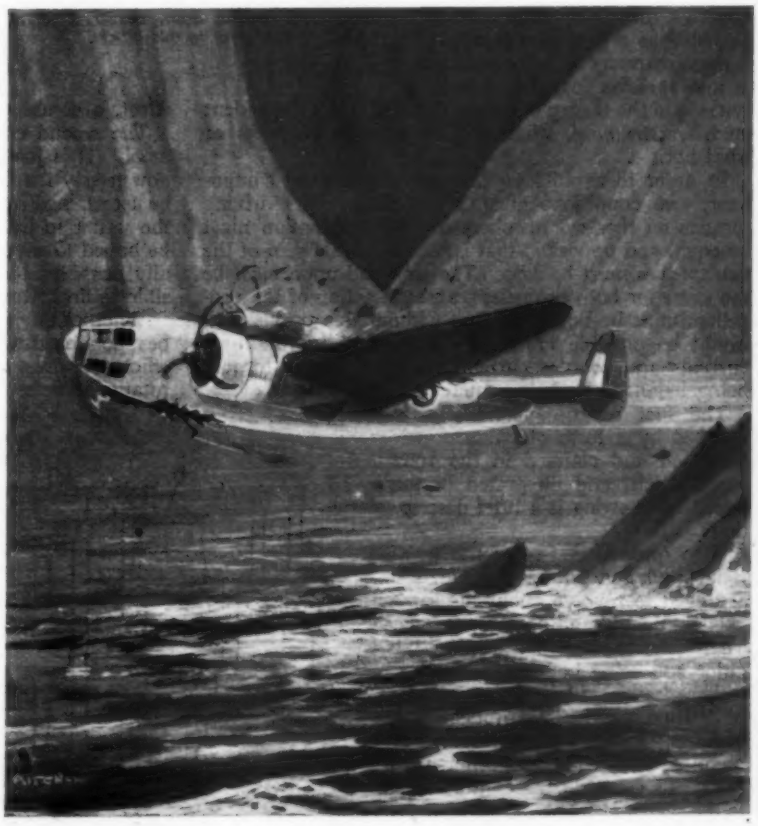
	Over G.B.	Over Continent	Middle East
Nov. 30	0	0	18
Dec. 1	1	0	9
,, 2	2	0	2
,, 3	0	0	1
,, 4	0	0	13
,, 5	0	1	22
,, 6	1	0	4
	4	1	69

Totals: North, 5,572; over 2,371. Middle East

BRITISH AIR LOSSES TO DEC. 6th.

	Over G.B. A'crft.	Over Continent B'brs.	Ftrs.	Pilots	Middle East A'crft.
Nov. 30	0	20	0	0	8 (1 pilot safe)
Dec. 1	0	0	0	0	0
,, 2	0	3	0	0	4
,, 3	0	0	0	0	0
,, 4	0	0	0	0	4
,, 5	0	1	5	5	6
,, 6	0	0	0	0	12 (3 pilots safe)
	0	24	5	5	34

Totals: North, 3,057; about 580. Middle East



An artist's impression of the Hudson aircraft which got home after striking a rock in Norwegian waters.

CONTRA-PROPS

Recollections of Early Considerations by Advisory Committee for Aeronautics : A Pioneer's 1907 Patent : Suggestions for Further Research

By F. W. LANCHESTER, LL.D., F.R.S.

THIS subject came prominently before the Advisory Committee for Aeronautics as long ago as 1918, when it received close attention. In a communication by the writer, dated May, 1918 (R. & M. 1918-19, pp. 634 to 642), the problem was dealt with from a theoretical standpoint, following the lines of the writer's exposition in his specification of Patent 9413A, 1907, published some ten years previously. In this he divided the energy losses as due to three distinct causes: (1) skin-friction and eddy making, sometimes termed *form resistance*; (2) the sternward component of the slipstream essential to propulsion; (3) the rotational component of the slipstream, whose angular momentum is a measure of the driving torque.

ONCE more it is our privilege to publish an article by Dr. Lanchester, "Grand Old Man of Aerodynamics." And once again one is amazed at the insight into the details of the mechanism of flight which he possessed in those very early days. As long ago as 1907 he not only visualised the advantages of contra-rotating airscrews, or as he termed them "co-axial propellers with reverse rotation," but he patented a form of drive, details of which are given in this article.

It was shown that, under ideal conditions, the whole of the energy loss due to the rotational component of the slipstream might be avoided, leaving (1) and (2) above as the only sources of loss. Of these, (1) alone is to be regarded as a *propeller* loss; (2) is more correctly to be considered as a *propulsion* loss, for it is inevitable in the theory of propulsion and is not dependent on the *instrument*, whether it be a screw propeller or what not.

In order to avoid loss due to the rotational component, two conditions must be satisfied. The driving torques on the two members of the combination must be equal and opposite; that is, the algebraic sum of the two torques must be zero. The air acted upon must be the same for both propellers, and the action of the propellers must be homogeneous; without this provision it would be possible for energy to be lost in rotational currents and counter currents, in spite of the torques being balanced by being equal and opposite.

The first of these conditions is satisfied by a form of balance gear described and claimed in the 1907 specification, and illustrated in the figure. Following is a brief description:—

Two propellers, respectively of right-hand and left-hand pitch, are arranged to revolve about the same axis with equal and opposite torque. Their shafts are concentric, the outer one being hollow.

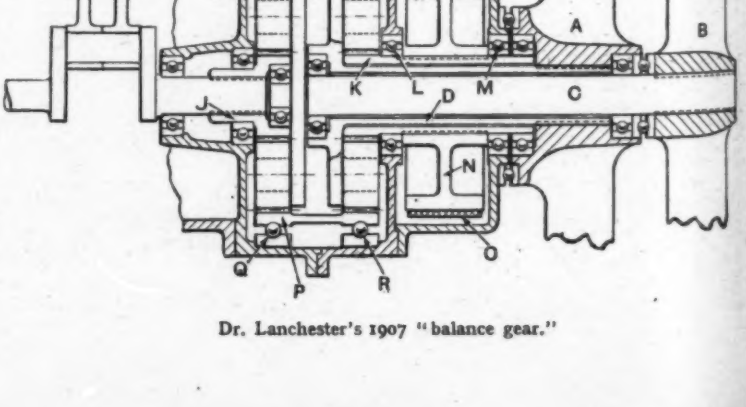
The drawing illustrates one form of the invention. Two propellers, A and B, of opposite hand, are mounted in driving connection with the shafts C and D, which are keyed to the planet elements E and F of the two trains of epicyclic gear contained within the casing G, bolted on to the extremity of the crank chamber H. One of the sun elements, J, is coupled direct to the motor shaft, and the other sun, K, is mounted to revolve in bearings L and M, and carries a brake drum, N, acted on by a brake shown as a band brake O. The ring element of the two trains of gear, P, is common to both, and is mounted in bearings in the casings Q,R, and is quite free to rotate, other than by its engagement with the planet pinions of the two trains.

When the sun element K is free to rotate, there is no driving effort exerted on either propeller; the planet elements can both stand still while both suns rotate in one direction, and the common ring element in the opposite direction.

When the sun K is brought to rest by means of the brake N,O, the planet elements are constrained to revolve (presuming the engine to be in action), but the extent to which they individually revolve is not determined except that, by the construction of the mechanism, the two propellers are acted on by equal and opposite torque. Thus the whole mechanism shown in the drawing is, in effect, a combined balance gear and clutch.

The second condition is by no means easy of fulfilment. It is just a question, as a practical problem, of how nearly the ideal can be approached; that can only be ascertained by experiment. As a "shot in the dark" the writer in his memorandum suggested that it might be hoped to save *half* of the rotational energy theoretically possible; his present view is that it should be possible to do better.

Whether the problem is to determine the data for the best possible design, or to find an expression for optimum efficiency, even on the supposition that the whole of the rotational wake energy is conserved, it is anything but



Dr. Lanchester's 1907 "balance gear."

easy. In fact, the writer believes that, up to the present, no theoretical solution has been discovered. The case for the combination put forward in his own memorandum (cited above) is far from convincing and in no sense final.

Beyond this a further unknown factor is introduced when account is taken of the loss of rotational wake energy due to the residuary turbulence in the rotational wake. As a problem to be settled by experiment, one method of approach is to take the individual propellers, as designed for ordinary duty, and mount them coaxially a sufficient distance apart to avoid direct interference. Then the leader will be running under normal conditions and show normal efficiency. The follower will be subject to two opposite influences, one tending towards a higher revolution speed due to the sternward wake being already established; the other tending towards a lower revolution speed due to the air on which it operates having opposed rotational momentum. It being assumed that the combination is driven through a balance gear, equality of torque takes care of itself. The combination is then tested in the wind tunnel and the results recorded and plotted.

The whole process is then repeated, using propellers designed on the same system but with a higher value of P/D (coarser pitch), and then again with a higher P/D ratio still. If the main contention in the memorandum is correct, there will be an increase in efficiency with increased P/D ratio till an optimum value is reached, which may be regarded as the practical solution. A falling efficiency associated with an increase in the P/D ratio would betoken that the optimum condition has been passed.

The gain to be anticipated from the use of a higher P/D ratio would be due to the lower blade-velocity for a given flight speed, and incidentally, a reduction in the propeller noise. Such higher ratio is permissible because a portion at least of the rotational wake energy is conserved. The procedure suggested above does not tell us how much, or what proportion of the rotational wake energy is conserved (that will depend upon the extent to which the action of the propellers on the air coming within their grasp is homogeneous), but it means that we reach a practical solution for optimum condition without such knowledge.

The experimental campaign would not be quite so simple as it might appear from the above description. Not only would the tests on each combination require to be repeated for many variations of velocity and thrust, the results being analysed in the form of plotted graphs, but side issues arise which would require independent examination. For example, owing to the contraction of the slipstream as and after passing through the leading screw, it is necessary that the follower should be of somewhat smaller diameter than the leader, in order that both should act on the *same column of air*. Then again the whole programme might need to be repeated with different numbers of blades, or with propellers based on different formulæ of design. Also there would be a preliminary enquiry to establish the minimum distance of separation consistent with non-interference.* Such work is worthy of the renewed attention of the staff of the N.P.L. with the equipment they have at their command.

* The following references may be given as relating to early investigations of the present problem: Technical Reports of the Advisory Committee for Aeronautics, 1918-19, pp. 642 *et seq.*, and p. 655, paragraph (4). Also (quoted on p. 643) R. & M., 421, 385 and 429. But as these latter do not appear in any index they are difficult to locate. These are additional to the writer's contribution, ref. pp. 634 *et seq.*

AUXILIARY SQUADRONS in the WAR

More than 200 Enemy Aircraft Accounted for : First to Fly Several New Types

PILOTS of R.A.F. Auxiliary fighter squadrons have already accounted for more than 200 enemy aircraft in offensive operations this year. This is over a quarter of the total number of German aircraft destroyed by Fighter Command in raids over the Continent and the enemy's seaboard since January.

In addition, members of Auxiliary squadrons have been pioneer pilots of new types of aircraft now being used against the enemy. It was an Auxiliary Hurricane squadron which opened the fighter campaign against enemy shipping in the Channel. An Auxiliary squadron was the first to be equipped with American Airacobra fighters, and pilots of another Auxiliary squadron made the first raids over France with bomb-carrying Hurricanes.

War of the Roses

The West Riding of Yorkshire Squadron and the West Lancashire Squadron have each destroyed more than 50 enemy fighters on offensive operations this year. In one week in June the West Lancashire Squadron shot down 17 Me 109s for the loss of only one of their own pilots. In one sweep they accounted for seven of the enemy. In July they shot another 17 German machines out of the French skies, including five in one day. Their brilliant fighting won them the congratulations of the Secretary of State for Air.

Like its colleagues from Lancashire, the West Riding Squadron was in at the start of the offensive. Until August the pilots were led across the Channel by a pilot who now commands a Spitfire Wing and has 17 German machines to his credit. Airmen from many nations have contributed to the success of this squadron. The personnel includes Belgians, Canadians, New Zealanders, Frenchmen and Poles.

Among other Auxiliary squadrons which have gained distinction in fighting over enemy territory are the South Yorkshire, County of Chester and City of Edinburgh Squadrons.

Attacks on Shipping

Early in September Fighter Command took a hand in the war against enemy shipping in the Channel. In new-type Hurricanes, pilots of one county squadron opened the campaign with low-level attacks on *flak* ships, patrol boats, minesweepers and tankers. This new form of attack was an immediate success, and within a few weeks the squadron had definitely sunk eleven vessels and damaged many others.

Pilots of the county squadrons fly at mast-head height to gun enemy ships and sweep in over tree-tops to release bombs on airfields, factories and gun posts. Once the bombs, which are fitted with delayed-action fuses, are dropped, the Hurricanes become fighters again, and the pilots seldom return until they have used up their machine-gun ammunition against enemy fighters or ground targets.

While the daylight offensive has been going on, other Auxiliary squadrons have been engaged in the night defence of this country. Although "customers" have been fewer lately, one squadron has now bagged more than 60 night raiders.

HERE AND THERE

Growing R.C.A.F.

FIGURES released by the Royal Canadian Air Force during October show the strength of the Force at that time at 83,000, compared with a pre-war strength of 4,500. Canadian ground crews are now operating in Britain and soon most Canadian squadrons will be serviced by Canadian mechanics.

About 1,000 radio technicians have for some time been assisting the Royal Air Force in detecting hostile aircraft, and 2,500 more such technicians will go overseas this year. A third class is now being trained in Canada.

Post-war Civil Flying

THE Royal Aero Club is now considering the question of British civil aviation after the war and the part which the Club will have to take as representing the interests of the private owners, the light aircraft clubs and also the gliding movement.

The Club has appointed a sub-committee to keep in touch with any developments on the part of the Government, who have set up an Inter-Departmental Committee to survey the whole question.

The Royal Aero Club Sub-Committee is composed of the following members:—

Lt. Col. Sir Francis K. McClean, A.F.C.
Sir W. Lindsay Everard, M.P.
Maj. R. H. Mayo, O.B.E.
F/O. W. R. D. Perkins, M.P.
Maj. H. A. Petre, D.S.O., M.C.
Lt. Col. R. L. Preston.
Harold E. Perrin, Secretary

Civil Flying in Canada

FOR the first six months of 1941 revenue passengers carried on Canadian air lines increased from 60,454 in 1940 to 78,193 this year, a report issued by the Dominion Bureau of Statistics at Ottawa states. The average flight has increased from 256 miles in 1940 to 304 miles in 1941.

Revenue freight carried amounted to 7,391,896 pounds during the first half of 1941 as compared to 5,168,744 pounds in the same period last year, while mail increased to 1,594,012 pounds from 1,271,893 during the same period.

No "Old School Tie" Nonsense

ACCORDING to Brig. Gen. Donald H. Connolly, Civil Aeronautics Administrator in America, a commendable drop in the number of violations of the Civil Air Regulations has gone hand-in-hand with a big increase in flying traffic during the first half of the present year.

"A feature of his report is that offending pilots are frequently reported by other pilots, which may seem a little "unsporting" to British wearers of old school ties. But they have a more practical way of looking at it in U.S., and the *Civil Aeronautics Journal* quotes the Administrator as saying:

"The fact that pilots will report other fliers for infractions of the safety rules points to the almost frantic devotion to safety that most people in aviation have to-day."

Believe It or Not!

"GEORGE," the automatic pilot, brought off a 100 to 1 chance by landing an empty aircraft successfully after the crew had baled out.

The crew of the aircraft had done a good job of work and were making for home in darkness and foul weather. Everything that could have given them guidance was hidden in mist. The wireless was faulty. They became lost. To attempt a landing would have meant almost certain disaster.

Petrol was running short, and while the last drops remained in the tanks, the pilot set "George" to take the aircraft in the direction of the sea so that it would not fall on a town. Then he and the crew baled out over land.

The aircraft was heard by the Observer Corps, who told the airdrome, which was nearer than the pilot had supposed. Soon the airdrome staff heard it approaching. They sent off rockets and flares but, to their consternation, the aircraft paid no attention and passed on towards the coast. Later, someone 'phoned up in great excitement to say that the aircraft had made an almost perfect landing on the beach—empty!

Temp. Lt. (A) G. C. McE. Guthrie, R.N.V.R., who was on H.M.S. *Ark Royal*, was recently awarded the D.S.C. In happier days, Giles Guthrie raced a Percival Vega Gull (D.H. Gipsy II) in which, with C. W. A. Scott, he won the £10,000 London - Johannesburg race in 1936, being the only finisher. He was fifth in the King's Cup race the following year and second in 1938.

Douglas Plant in Africa

A LARGE factory for the reconditioning, repair and overhauling of American-built aircraft operating in the Middle East is being erected "somewhere in Africa" by the Douglas Aircraft Corporation.

This was revealed by Brig. Gen E. E. Adler, Chief of the U.S. Air Service, when he arrived recently in Cairo with a group of experienced American pilots and technicians to supervise the proper distribution of American material, particularly aircraft, and to make sure that all aspects of the undertaking were fully understood. His visit also concerned the training of British pilots for U.S. aircraft.

The new plant will play an important part in the formation of a vital new "life-line" between Washington and Cairo which aims at preventing any hitch in the delivery of Lease-Lend material and ensuring its best possible use on arrival there.

General Adler's appearance in Cairo was made in the course of a round of visits to his new command which is said to extend "from West Africa to Singapore."

ADVERTISED GOODS

THE fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.

Two enormous concrete single-span hangars at the United States Naval Air Station on North Island, San Diego, California. They are strongly reminiscent of the airship hangars at Orly, near Paris.

"MET." W.A.A.F.S.

Some Photographs of an Interesting "Trade" Open to Physics and Maths Girls

A DEPLORABLE occurrence which illustrated the importance of an efficient weather service was the recent loss of 37 aircraft in one night owing to the sudden development of icing conditions over Northern Germany. Had these conditions been forecastable it is probable that the operations would have been called off.

Many jokes have been made at the expense of "weather," but actually the meteorological service of the R.A.F. is without peer the world over. In other climes where more settled atmospheric conditions obtain, the "Met." officer's life is one of comparative ease. In England, however, the weather map is usually full of "High" and "Low" contours, and any forecast can be only of short duration.

Girls of the W.A.A.F. are now employed at R.A.F. stations to collect and collate the data on which the forecasts are based. Training in the use of instruments and apparatus for measuring the velocity of upper winds, the height of clouds and kindred subjects is given after enrolment.

1

2

3

(1) Handing a weather report to a sergeant pilot.

(2) Taking thermometer and barometer readings.

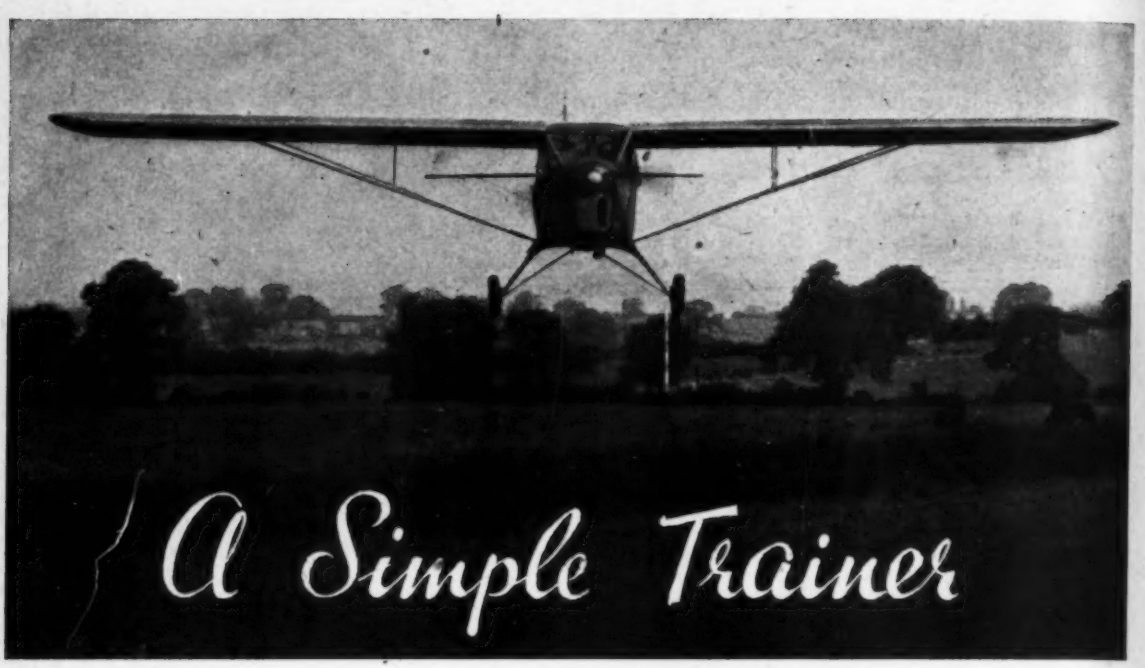
(3) Releasing a balloon to measure wind speeds at various altitudes.

(4) "Following" the balloon with a theodolite.

(5) Measuring the temperature eight miles above the ground by means of radio signals from a set attached to a "met." balloon.

4

5



A Simple Trainer

Features of the Two Types of Taylorcraft

IN discussing the form of ideal trainer in an article in the issue of October 2nd, "Ex-R.F.C." laid down certain desirable points of design in his ideal specification. The importance of an enclosed cabin with side-by-side seats was stressed and a monoplane type of aircraft was favoured.

Taylorcraft Aeroplanes (England), Ltd., have directed our attention to the fact that the latest Taylorcraft machine embodies most of the pilot's requirements set forth in the article referred to. Among items of the specification suggested which are fulfilled in the Taylorcraft are the following:—

Side-by-side cabin.
Direct normal conversation.
Good forward and side arc of vision.
Dual control, stick or wheel.
Metal construction not affected by weather.
Maximum speed, 120 m.p.h.

Manoeuvrability demonstrated: In the picture of the Taylorcraft climbing the position of the elevators indicates that the pilot was just about to flatten out when the camera shutter opened, but the machine had not yet answered the control.

SIMPLE TRAINER

Landing speed, 38 m.p.h.
Climb, 1,300ft. per minute, or 1 in 3.
Range (maximum), 350 miles.

By satisfying the ideal specification set forth by "Ex-R.F.C.," quite naturally a number of disadvantages he instances are automatically overcome. Messrs. Taylorcraft also emphasise that one of the points to recommend the aircraft for Army use when engaged on spotting, reconnaissance and such like duties is that it can be landed on a road or small field, for the landing speed is only 38 m.p.h. and it is capable of taking off in 125 yards.

In this connection it is not uninteresting to recall that in the Army manœuvres in the United States of America some months ago, light planes were employed experimentally for the first time. On the whole they proved to have their uses in certain circumstances, and the U.S. Army Air Force is now considering how to employ them to best advantage. In this country, too, the light plane could serve useful purposes.

There are two examples of the Taylorcraft available, one of 55 h.p. and another of 100 h.p. For purposes of comparison we quote in the accompanying table the desirable points of an ideal specification for a primary trainer as envisaged by "Ex-R.F.C." and those embodied in the two types of Taylorcraft:—

The latest Taylorcraft light plane has side-by-side seating and a 100 h.p. engine.

	"EX.-R.F.C."	TAYLORCRAFT	
Engine	**90 h.p.**	**100 h.p.**	**55 h.p.**
Cruising speed ..	100	110	90–100
Maximum speed	115	120	105
Initial climb ..	750ft. per min.	1,300ft. per min.	500ft. per min.
Weight empty ..	850 lb.	850 lb.	700 lb.
Weight loaded ..	1,450 lb.	1,400 lb.	1,200 lb.
Cruising duration	3 hours	3 hours	3 hours
Wing span	33ft.	36ft.	36ft.
Length	24ft.	22ft.	22ft.

CAPT. H. BALFOUR ON RUSSIA

CAPTAIN H. H. BALFOUR, M.C., Under Secretary of State for Air, in the course of a recent speech, gave some of the impressions he had formed during his recent visit to Moscow. "Though I sit in Parliament as National Conservative Member for the Isle of Thanet, traditionally a Tory seat," he said, "yet I have dined with Stalin in the Kremlin and I am proud to have touched glasses with him in a toast to our two Air Forces and their common fight. Though I abhor the political doctrines of Communism, yet I have met Soviet Commissars in negotiation and we have found common agreement. To-day anyone who kills Germans is my best friend, and the Russians are killing untold Germans and themselves dying bravely for their land.

"The chief impression left with me of Stalin, his Government and his Capital, is the fixed certainty that whether things go well or badly on the Eastern Front—whether or not Moscow is eventually captured—Russia will fight on bravely until victory. The enemy may overrun the land, but this will not crush the determination of the *moujik* to be rid of the foreign invader. It will not be the courage of the Soviet airmen or the tenacity of their ground troops that are captured—for these will prevail to the end. . . .

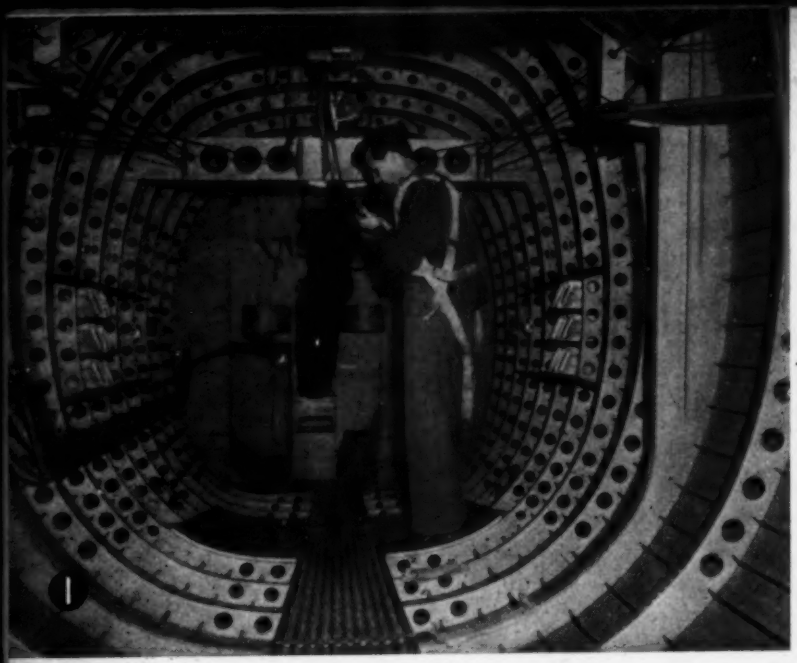
"I am sure that the Russians will put to good use those aircraft sent them from U.S.A. and Britain. Workers in our aircraft factories feel justly proud of the Royal Air Force who use their products; and so can they feel with equal confidence about the Soviet airmen. The Russians are splendid technicians. They erected our modern fighters in a few hours, working in exposed conditions without thought of rest or food. Those Russian mechanics did a great job. Their pilots flew these aircraft without difficulty and off an airdrome built in some thirty days. It is unorthodox to build an airdrome in days. It may shock the conventional outlook that an airdrome must take months to build, but the thing that matters is that the airdrome worked and did its job.

"Russia is a vast country, with the disadvantage of thin communications of telegraph, telephone, road and rail; but after all, both sides fighting on Russian soil have to face these same conditions. If both sides are using modern air equipment, is it not likely that those born there, and who have lived, fought and died always contesting difficulties and limitations imposed by nature, will get better use out of their equipment than a force accustomed to the luxury of air operations from well-equipped and settled bases in Germany and Northern Europe?

"Russian air equipment is formidable. At one factory I saw a vast number of fighters in various stages of final assembly. They were different aircraft from ours, but were good aircraft all the same—peculiarly suitable for the Russian needs. Their factory machine tools, their heat treatment, their technical processes, were efficient and modern. Their engineers knew their jobs. The men and women workers, like ours, were working all out. From our factories rises the cry 'Aid to Russia.' As we walked through the factory I had one sentence of a Russian worker translated to me. It was 'Aid to Britain.' Surely the real answer is 'Joint aid for the downfall of Hitler and his gangsters.'

"I left Russia heartened and cheered by what I had seen and felt from their people. I left impressed by their engineering ability and by the quality of their equipment; but more than this, by the sense one felt around one that the Russian will fight for his country to the last—and that the last shall be our common victory. . . .

"I look forward to the day when German representatives will come as suppliants, terror-struck and repentant, but too late, asking what terms we would grant her for surrender. This is the thought, the hope and the certainty in the minds of all of us: and the events in the East, in the West and in the South, on the seas, in the air and on the land as, day by day, they pass, are surely bringing nearer this time."



TRIALS COMPLETED

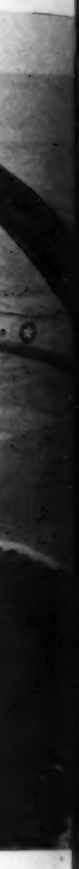
Douglas B-19 Passes Its Flight Tests : Crew of 10, and 18 Tons of Bombs

WHATEVER may be one's views of the practical utility of the world's largest landplane, the Douglas B-19, one cannot but admire the courage of those who sanctioned its construction. With a wing span of 212ft. and a normal gross weight of 140,000lb., this giant must have presented innumerable problems to the designers. That the Douglas engineers have succeeded in producing an aircraft of such size which flies and handles sufficiently well to pass the acceptance tests of the U.S. Army Air Forces is an achievement of which all our good friends in the United States may well be proud.

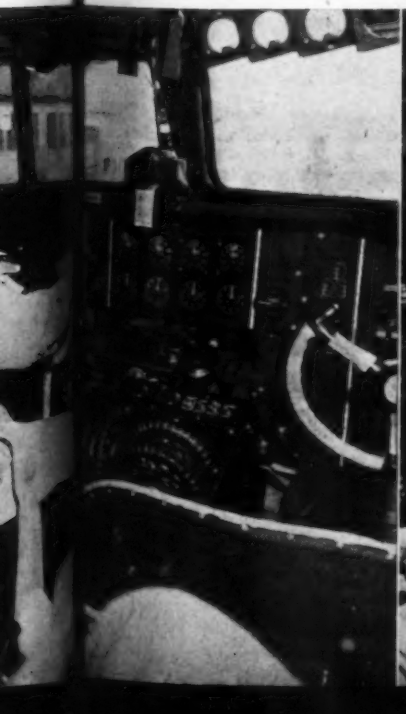
The performance is not spectacular ; top speed is given as 210 m.p.h. and cruising speed at 186 m.p.h. But it must be remembered that the Wright Duplex Cyclones fitted are at present rated at 2,000 h.p. for take-off, which gives a power loading of about 17 lb./h.p. at normal gross weight. There is little doubt that the B-19 was designed on the assumption that later on much more powerful engines would be available. These will, in fact, be necessary if the aircraft is to operate at the designed overload gross weight of 160,000lb. for which the structure has been stressed.

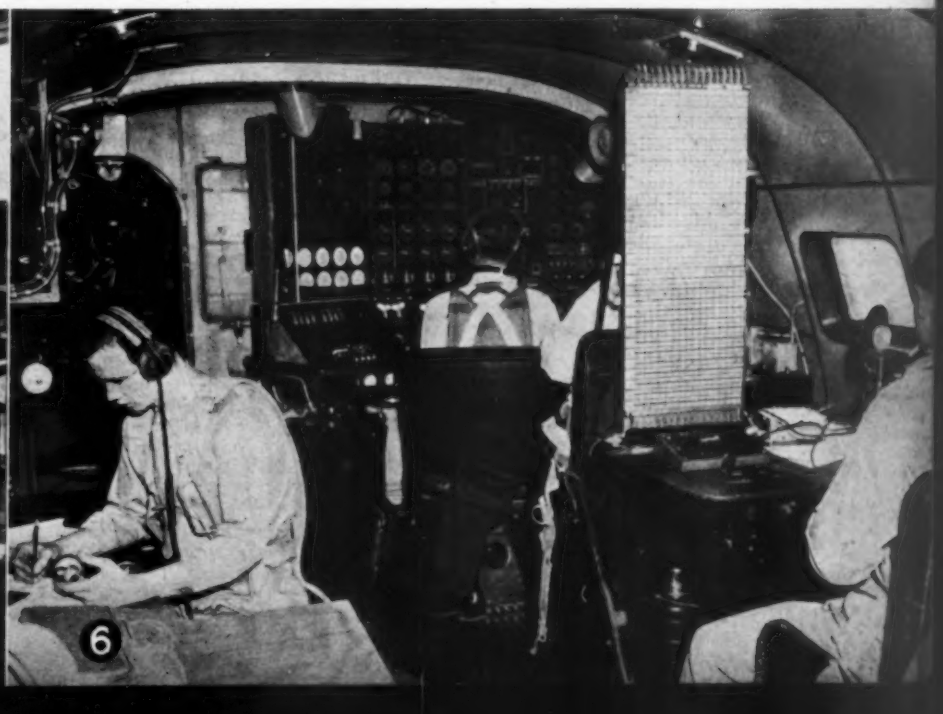
Fuel tankage of the B-19 has been given as 11,000 U.S. gallons, which should give the machine a still-air range of about 7,500 miles. With its full bomb load of 18 tons, the range will be shorter.

The largest landplane in the world. (1) Lt. Doyle at the inter-communication telephone in the rear compartment of the Douglas B-19. (2) The B-19 in flight above its native California. (3) Engineers have to be steeplejacks to get at the dynamically-mounted Wright Duplex Cyclone engines. The inspection panels in the cowlings are interesting. The 3-bladed airscrews are of 16ft. diam.



Three illuminating views inside the giant B-19. (4) Is a view looking forward from the radio operator's position. (5) Shows Lt. Col. Umstead, in command of the B-19. The cigar is not part of the regular service equipment. In (6) is shown the after end of the control compartment, with radio and control panels. The B-19 completed its acceptance tests on November 8th.





Topics of the Day

NOT JUST MAN POWER

Strangely Varying Types Who Can Make Good Pilots : Apology for Aces and Those Who Hate Gadgets

NO doubt the good Central Medical Establishment—or, perhaps, some Psychological Centre of Cerebral Uncertainties—has already laid out a vast and complicated series of rules and regulations to explain the Good Pilot and his make-up in relation to that of the Bad Pilot. That is, if there *is* such a thing as a bad pilot when the correct method of instruction has been found for those who do not quite fit into the general mould. Any remarks of mine must, therefore, be treated with caution, the conclusions studied with the greatest possible degree of reserve, and the whole article, in fact, treated, if necessary, as a joke in rather bad taste.

But the majority of people who have been at all mixed up with those who aviate must have been struck by certain similarities, as well as by some very strange anomalies which must be explained by basic and almost subconscious features of similar character. I am not so much interested in the difference between the aggressive and non-aggressive types among the pilots—such differences are much more easily explained away—as in the physical and mental characteristics which distinguish those who become good, safe pilots (in peace or in war) and those who either never become pilots at all, or who jog along as very indifferent and even dangerous pilots until they finally give up.

Applied Science

The entire question has been made all the more difficult by the fact that flying to-day is more a matter of applied science than the good old business involving only a nice touch, a sense of balance, good judgment, and a certain lack of unnecessary imagination. These qualifications are still necessary to get a prospective pilot past the first hurdle—he must, in fact, learn to fly in the old-fashioned way before he has a chance of applying any science in complicated flying bricks and glass-covered pantechnicons. They are perhaps all the more necessary in the later stages because the pilot must to-day fly without thinking, while his entire mental energy is devoted to the business of wrestling with mechanisms of different kinds.

I have almost regretfully come to the conclusion that the basic attribute of all good pilots is lack of what I call "unnecessary imagination." Either he or she must be naturally without much imagination, or must be able to maintain complete control of it. The very best pilots are probably in the last category. They visualise the possible dangers without allowing the desperate visions to cloud the judgment or cause what is usually known as a "flap"; they know the worst (and consequently endeavour to avoid it) without brooding on its frightfulness; they appreciate the very real difficulties without being overcome by them, and consequently always do their best; they refuse (because their minds are under full control) to be disturbed by extraneous happenings; and they use their imagination to the full in its controlled state.

Apparent Contradictions

So you have the strange anomalies. Pilots who seem to be quite desperately slow in the uptake and yet who are magnificent in the air; pilots who are quick and excitable, yet never do the wrong thing; pilots who appear always to be nervous, and especially so on the ground; pilots who could never play a decent game of anything, yet who pull off a monotonously perfect series of approaches and landings. . . . One could continue almost indefinitely. The same story is behind them all—controlled imagination or no imagination at all. There is no need to think quickly so long as the thinking is not accompanied by a muddled redness before the eyes—the result of an uncontrolled imagination and consequent "flap." You can be as excitable as you like so long as you always think concisely. You can even be frightened so long as you don't allow the fear to cloud or warp your judgment; fear may even make you think more clearly in tight corners when it is properly bottled up. If you are no good at games then you use your brains to devise new methods of assisting judgment of which you may have some doubt—though there is no possible similarity between the work of hitting a moving object with a bat or racquet and that of judging height, speed and stalling or sinking "feel" in a large or a small aircraft.

The Only Explanation

As I say, it seems to me that the person who can control his imagination, and can consequently keep his brain quite clear all the time, can cope with aircraft more satisfactorily than anyone else. That is the only theory which will explain the very strange, different, and even sometimes frightened, people who become very good pilots—and, for that matter, very good war pilots. In extreme cases, the best war pilots are often those who are most frightened; perhaps because they are tense the whole time and also because they fear being afraid far more than they fear the physical dangers involved.

During the last 15 years I have met quite a few flying persons who fall into a very special category of their own. They have all been pilots of the old school who have never done anything but fly, and who don't want to do, and never will do, anything else but fly. Some of them have been good instructors, and all of them have been and are good, natural pilots, but I don't remember one who has made a successful airline or war pilot of the modern school with applied science and all that. They will fly anything anywhere by their instincts and natural air sense, but without any despised and highly specialised aids to navigation. Usually they dislike blind flying and do not attempt to understand gadgetry. In the days before the invention of the flying machine they possibly had no very special place in the world; it is, in fact, difficult to know what they could have done because they are so essentially bound up with flying.

Phrenological Aspect

At the moment of writing I can think of four such examples who, though outwardly dissimilar in character and habits, are essentially similar in make-up. Perhaps not so strangely, all four have the same shape of head. There is something very important about that and possibly a scientific rather than a quack phrenologist could explain the phenomenon. To anyone who is interested I will send a sketch of the shape in question, but if I described it now there would probably be such a howl from all those people whose heads are similarly shaped but who have never been near an aircraft that I should never hear the end of it. All I could say to them is that if they had had the opportunity—or been able to control their imaginations—they would now be crack pilots. In any case, the four examples are perfect ones. The head shapes are identical and each is, or has been, right at the very top of the flying tree.

Unhappily for them, they don't fit in quite so well with modern ideas. If wing-loadings go up any more, if machines become any more complicated, and if the simple affair of flying from A to B brings in too much additional theory, the type will die out. That will be more than a pity.

"INDICATOR."

Sixteenth of the Second Series

FRIEND or FOE?

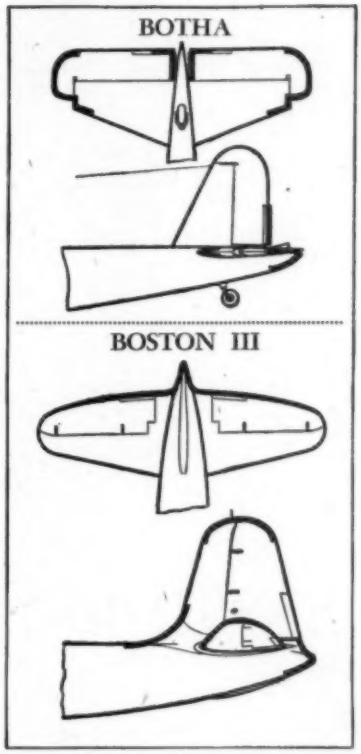
Two Unusual Bomber Tails : The Botha and Boston III

BOTHA: Large ungainly fin and rudder with vertical, trailing-edge and projecting trimming tab. Tailplane set well back, tapered leading-edge with line broken near round tips by elevator horn balances. Fixed tailwheel.

TO make it still easier for the beginner in aircraft identification to spot at once the outstanding characteristics of the tail units illustrated, week by week, in this series of articles, it has been decided to thicken the outline of such portions as call for special notice. Reference to the accompanying plan and elevation drawings will show how much more quickly and surely the salient features can be appreciated by means of this method.

This week's selected pair of tails are those of the Blackburn Botha trainer-bomber and the Douglas Boston III attack bomber (or Havoc, in its night-fighter form). There should be little possibility of any confusion between these two aircraft, though they have one or two points of similarity. The Botha, for example, is a high-wing design and the Boston a high mid-wing (or shoulder-wing); a small difference which might not be too obvious under certain circumstances, but their wing-plans are very different and, if visible, could not possibly be confused.

Their respective tails, too, have this much in common; the rudders are mounted wholly above the fuselage, the extremities of which project beyond the trailing-edge. But there all similarity ends, for it must be honestly conceded that the American machine is far and away more graceful than this useful, but decidedly angular British machine.



Let us first of all consider the vertical surfaces. The fin of the Botha forms a sharp angle where the foot of the leading-edge slopes up in a straight line from the fuselage, and the vertical trailing-edge of the rudder meets the horizontal line of the projecting fuselage in a definite right angle. Compare this with the elegant curves of the Boston's fin and rudder, the leading-edge of which sweeps smoothly up from the fuselage, while, from the rounded apex, the trailing-edge curves downwards, and outwards at the foot to blend into the extremity of the fuselage.

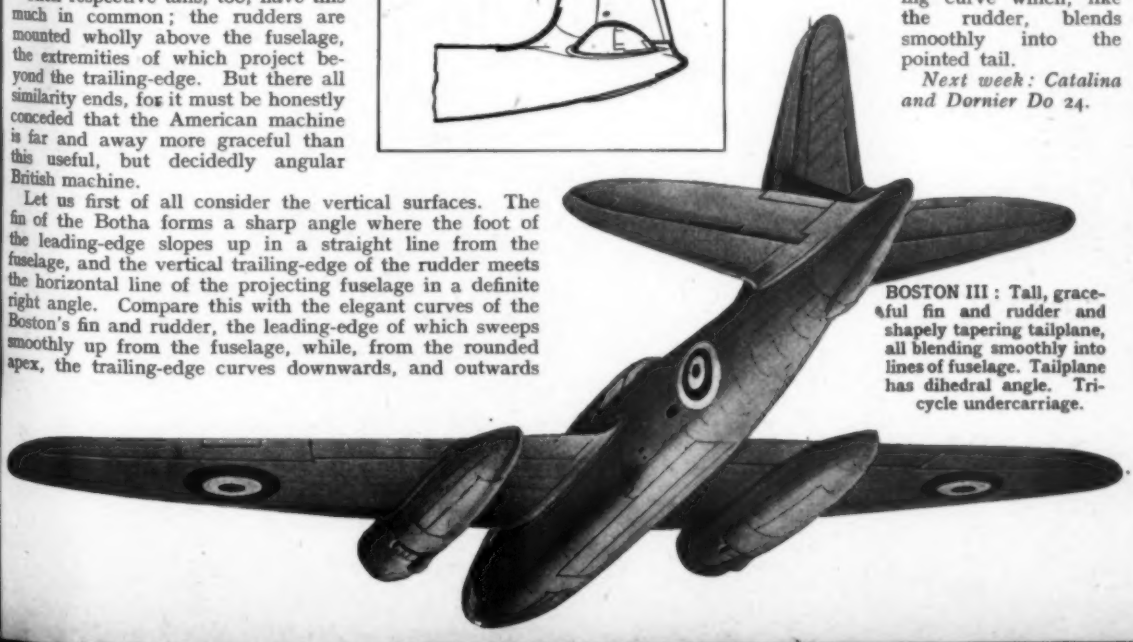
Similarly the tailplane of the Botha, which, it will be noticed, is set well back in relation to the fin, makes no pretensions to beauty of line as does the gracefully proportioned tailplane of the Boston.

The former's leading-edge, in fact, has an indentation near its broad tip where the horn balance of the elevator stops short of the tip-chord of the tailplane-proper. The inner edges of the elevators, where they clear the tapered tail of the fuselage, are also severe right angles, but the outer corners of the trailing-edge are rounded.

As M. Panhard is reputed to have remarked about his crash gear-box, "C'est terrible, mais il marche!"—or words to that effect.

The Boston's tailplane, however, has the unusual distinction of being set at a dihedral angle, and its outline conforms to the general elegance of the aircraft as a whole. It tapers on its leading-edge to fairly small, round tips, while its trailing-edge, embodying inset elevators, forms another sweeping curve which, like the rudder, blends smoothly into the pointed tail.

Next week: Catalina and Dornier Do 24.



BOSTON III : Tall, graceful fin and rudder and shapely tapering tailplane, all blending smoothly into lines of fuselage. Tailplane has dihedral angle. Tricycle undercarriage.

GERMAN AIRCRAFT RADIO

American Experts Not Impressed : Obsolescence Ascribed to Too-early "Freezing" of Design

SOME months ago British technical journals were permitted to inspect the radio equipment of German aircraft brought down in this country. On the whole they praised German workmanship, but saw nothing in the design of the radio equipment to cause uneasiness. It is interesting to find that American radio experts have come to the same conclusions, as indicated by a report issued by Mr. William P. Lear, designer of Learadio for the United States air forces. Following are extracts from his report.

The equipment tested was installed in a German Messerschmitt 109 shot down over the Thames estuary. The machine was shipped to the United States through arrangements made by Mrs. Winston Churchill, honorary sponsor of "Bundles for Britain." Upon its arrival in America, Lear engineers removed the radio apparatus, and the equipment was thoroughly tested by Mr. Lear in his laboratories at Lear Avia, Inc., Piqua, Ohio.

Mr. Lear's report on the German radio equipment stressed four points:—

(1) The Germans have apparently "frozen" their military radio design since 1933, and standardised their valves and components for ease of mass production servicing.

(2) Shortages of war materials are indicated by the use of ceramics instead of plastics, fibre instead of rubber and special alloys instead of aluminium.

(3) The extremely limited range of the transmitter (around five miles), and the provision for higher power output, indicate that most German warplanes in a given squadron can talk only to one another, while the leader only can communicate with his base.

(4) German aircraft radio apparatus found in the Messerschmitt cannot pass U.S. Government test for even commercial radio equipment, and weighs more than comparable American apparatus.

Limited Range

Examination of the radio equipment from the Messerschmitt indicates very definitely that it is intended primarily for communication over very limited ranges. The equipment is comprised of a low-power transmitter sufficient for interplane communication; a receiver, and a power supply unit. The receiver is relatively insensitive, and the transmitter output is so limited that it cannot be picked up by the enemy at a distant location. The frequency range of the equipment is from 2,500 to 3,700 kilocycles, which in itself represents a very narrow band for communication purposes. Both the receiver and the transmitter are tunable in this range of frequencies. The equipment weighs in the neighbourhood of sixty pounds.

In general, the equipment is built very rugged, and the chassis of both the transmitter and the receiver are lightweight castings. The material used is Elektron, which is a special aluminium alloy having a high percentage of magnesium.

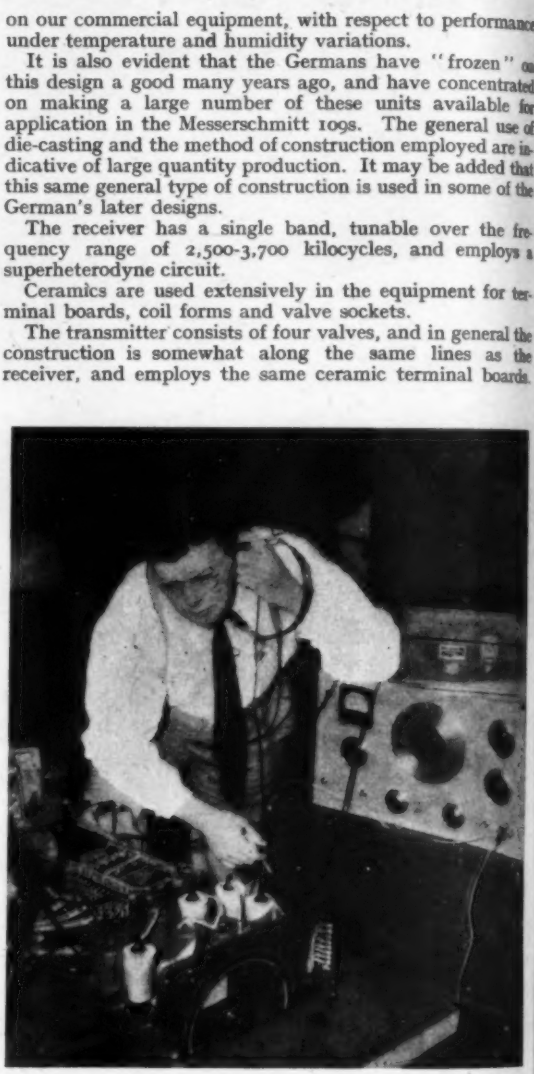
The workmanship included in the German equipment is very good. However, the equipment as a whole will not meet the requirements which we in America impose even on our commercial equipment, with respect to performance under temperature and humidity variations.

It is also evident that the Germans have "frozen" on this design a good many years ago, and have concentrated on making a large number of these units available for application in the Messerschmitt 109s. The general use of die-casting and the method of construction employed are indicative of large quantity production. It may be added that this same general type of construction is used in some of the German's later designs.

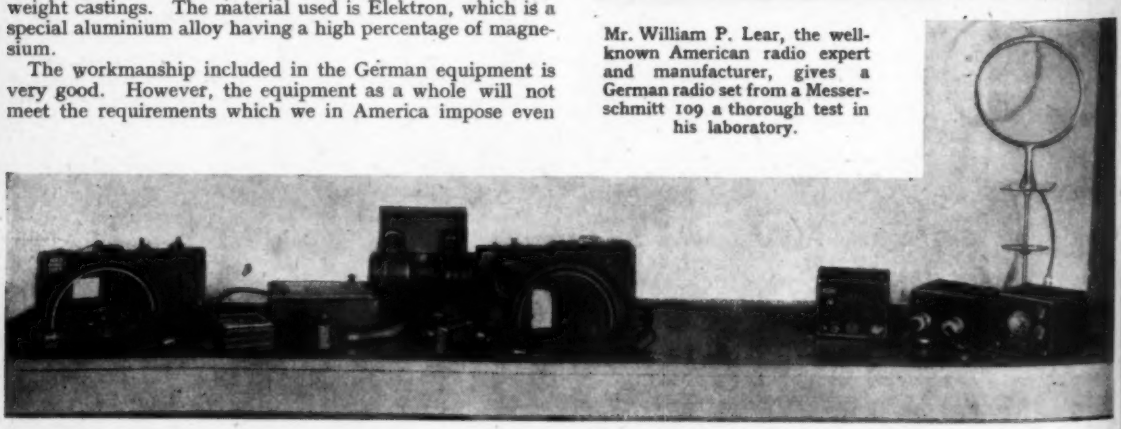
The receiver has a single band, tunable over the frequency range of 2,500-3,700 kilocycles, and employs a superheterodyne circuit.

Ceramics are used extensively in the equipment for terminal boards, coil forms and valve sockets.

The transmitter consists of four valves, and in general the construction is somewhat along the same lines as the receiver, and employs the same ceramic terminal boards.



Mr. William P. Lear, the well-known American radio expert and manufacturer, gives a German radio set from a Messerschmitt 109 a thorough test in his laboratory.



Comparisons are odious but . . . . On the left is a German radio set from a Me 109, and on the right a comparable Learadio set, which has in addition a direction-finding loop.

RANGE and FUEL ECONOMY

Some of "Jinair's" Arguments Challenged : Flying at Maximum Lift-drag Ratio Gives Greatest Endurance, But Not Greatest Range

By C. L. HININGS, B.Sc.

TWO articles in *Flight* of September 18th, 1941,* indicate the close attention which is being paid to the vital subject of range, fuel economy, and best methods of handling engines in operational flight. There is no doubt that, with the advent of four-engined bombers of increasing engineering complexity, it will be necessary for either the pilot to be an engineer or for a crew to include an engineer. As range is not solely a matter in which heavy bombers are interested, but also becomes vital for the single-seater fighter in convoy work and Continental sweeps, both of the above alternatives have to be considered, and both, to my knowledge, are receiving the close attention of Training Commands.

Many pilots are extremely keen to arrive at sound conclusions concerning the best use to be made of their engines and fuel tankage. It is to be feared that your article by "Jinair," when perused in the ante-rooms of officers' messes or the crew rooms of operational squadrons, will fail to be of assistance, and, indeed, containing technical inaccuracies, may "brown them off" and scare them from seeking the clear guidance to which they are entitled.

Four Points

The following points should be noted:—

(1) Range is a matter of miles per gallon, not gallons per hour. "Jinair" seems to confuse range with fuel economy in his first two sections.

(2) The attitude of the aircraft corresponding to the A.S.I. recommended for maximum range is not that which gives the maximum L/D ratio, and the b.h.p. required for this A.S.I. is higher, and the consumption in g.p.h. is higher, than when flying at maximum L/D.

(3) H.P. required at the A.S.I. corresponding to maximum L/D ratio is the minimum to sustain level flight, and flying in level flight at this A.S.I. (lower than the recommended value for maximum range) will give conditions for maximum endurance. Endurance is the factor which can be expressed in gallons per hour and means ability to stay in the air the longest time for a given expenditure of fuel.

(4) "Jinair's" statement that low r.p.m. and large throttle openings entail great danger from detonation is not correct when applied to a power plant using the constant-speed airscrew, but derives from the old conception of a car labouring up a hill in top gear with a wide throttle, or an aero engine developing a high B.M.E.P. while its speed of rotation is tied down by a fixed-pitch airscrew rotating in an atmosphere of sea-level density.

It is possible, within the range of control of a constant-speed lever, so to reduce the speed of rotation of the supercharger impeller that the engine throttles will be wide open in order to maintain a boost, and therefore B.M.E.P. well below even the economical cruising boost of the engine. It is difficult enough to get pilots to understand that they are doing no harm to their engines by using them in such conditions of full-throttle reduced r.p.m. without perpetuating "Jinair's" bogy. In any case, it is futile to talk to pilots about B.M.E.P.s.

Admittedly, from the research establishment's point of view, range and endurance are both complicated by the presence of a considerable number of variable quantities. So far as the Service pilot is concerned, the problem is relatively simple. Maximum range at a given altitude and given all-up weight (say the average for the outward journey) will be obtained if he flies the aircraft at the maker's recommended A.S.I. and adjusts his engines by means of constant-speed control and throttle, so that they are running at a reduced r.p.m. and the boost given by full throttle within the economical (weak mixture) cruising boost limitation.

In attaining this condition, it will be noticed that at first, when reducing r.p.m. on the constant-speed control, the boost gauge stays put. This is because the boost regulator is opening the throttles to maintain a boost whose tendency would be to drop owing to the reduced speed of the supercharger impeller. Further reduction of r.p.m. will begin to pull the boost down as well, because by now the boost regulator has opened the throttles wide and can do no more. The pilot will then select that position in the constant-speed control at which his engines are giving the power to sustain his flight at the recommended A.S.I. The decision as to what particular altitude he should fly at is more likely to be dictated by meteorological conditions and hostile action.

Altitude

Regarding altitude, however, the question of selecting the best ratio of a two-speed supercharger requires considering; below a certain "change-over height" it is impossible to get better performance, range, or anything else out of the high-speed section. Above that change-over height, so far as range is concerned, there is a tom-tiddler's ground in which either the moderate or full-speed section can be employed without adverse effect, provided that the golden rule of full-throttle reduced revs within the economical cruising limitation is observed. At still higher altitudes it will become necessary to use the high-speed section of his engine, as the power required for the recommended A.S.I. would not be obtainable otherwise. Exactly the same reasoning applies, that for best range at these higher altitudes he should obey the golden rule of flying at the recommended A.S.I. with his engine in full-throttle reduced r.p.m. setting.

Range is usually the primary consideration before and after making contact with the enemy. During contact, e.g., to shorten time of flight over hostile territory, increased A.S.I.s giving correspondingly increased true air speeds should, if possible, be obtained by increasing r.p.m. on the constant-speed control, still remaining

* "Range and Fuel Economy," by "Jinair," and "Mechanical Flight Computor" (Librascope), by H. W. Perry.

within the economical cruising boost. This will conserve at any rate some attribute of range. But when things get really hot, range goes by the board, powers go into rich mixture, A.S.I.s increase until the emergency is passed.

Other circumstances may arise in which range *per se* is secondary to endurance as, for example, on convoy work, waiting for a fog to clear before landing after an operational trip, or when short of petrol over the sea, to prolong the time in which to find a ship near which to put the aircraft into the ditch. For endurance, then, the least usage of fuel is indicated. This will be with the A.S.I. still further reduced so that the thrust h.p. is the minimum required to maintain level flight. In other words, the pilot should seek to have his aircraft just pleasantly manœuvrable and responsive to controls above the stalling speed and at a fairly low altitude at which he can still get the full-throttle reduced revs condition. Whilst no one would expect a pilot to be happy with his engine at extremely low revs, there is usually a vaguely sensed low value of r.p.m. at which the engine appears to be running sweetly. For maximum endurance he should, therefore, if possible, reduce his A.S.I. by a still further reduction in r.p.m. on constant-speed unit, and this may also entail some degree of throttling as well, in order to have a contented engine.

Finally, the question of airscrew efficiency, introduced by "Jinair," does not invalidate the above arguments.

You will notice that I do not join issue with "Jinair" on his statement that a proper attention to these problems would result in saving many lives and many aircraft. The proper place for our new pilots to be thoroughly grounded in the art of handling their engines is the O.T.U and it is to be hoped that in every such Operational Training Centre there are ground instructors and officers of an authoritative rank who are both pilots and engineers to drill their charges so that correct methods become second nature, while still leaving them with the essential devil which prompts the lighthearted generation to open up everything.

C. L. H.

STILL TRYING

APPLICATION was made on December 2nd to the American Civil Aeronautics Authority by American Export Airlines for permission to operate an air service for passengers and mails between the United States and the United Kingdom, or, more specifically, between New York and Southampton via Foynes. This is interesting in view of the fact that some months ago the U.S. Senate refused to grant funds for the establishment of such a service. Presumably, A.E.A. intend to run the service without help from the Government, and in competition with subsidised Pan American. The Sikorsky firm is constructing for American Export Airlines some four-engined flying boats, which would appear to be well suited for the service. A picture appears below.

FOR THE NEW YORK - SOUTHAMPTON SERVICE? A four-engined Sikorsky flying boat in course of construction for American Export Airlines. It may be put on the Atlantic run referred to above.

TECHNICAL TRAINING

How the Requisite Thousands of Royal Air Force Ground Staff are Being Trained : Poles Undergo Training Under Their Own N.C.O.s

A W.A.A.F. corporal at a School of Photography learns the use of a stand camera. Women are proving very adept at photographic work.

IN the 1914-18 war it was computed that each aircraft required ten people on the ground to keep it in the air. At the end of hostilities we had, if memory serves, some 30,000 aircraft of various types and a personnel of round about 300,000. Quite obviously, 30,000 aircraft is not our aim in this war, and, remembering the added complication of the present-day machine, it is equally obvious that a fantastic number of highly skilled tradesmen is required.

To cope with this demand, huge training establishments have grown up all over the country, and it is one of these which we visited recently.

At one centre many courses of varying length are proceeding side by side. Most of the courses are for men, but there is also a considerable intake of girls for the W.A.A.F. These latter are mostly fabric workers, cooks, batwomen and motor transport drivers, while the men are trained in such trades as armourers, blacksmiths, turners, grinders, millers, fire fighters and butchers. There is also an officers' motor transport course.

Many of us can remember the soul-destroying training of the last war, when it was considered a most important point that no work done by trainees was to be useful. It had to be as uninteresting as possible and thrown away immediately it was completed. To-day it is the reverse, and roughly 90 per cent. of the work done in this particular establishment can be considered as production. For instance, the trainees repair and maintain the whole of the motor vehicles employed on the station. The test piece of work for fitter-armourers is a special spanner which would otherwise have to be made in an outside factory, taking up valuable man- and machine-tool hours.

Before arriving at the school the men and women have been to a depot for a while, where they are fitted up with their outfit and taught the elements of leading a barrack existence. That this is done very thoroughly in a short time is testified by their smart bearing in quarters and on the parade ground.

For all men up to 35 years of age (exercise is voluntary for those over middle age) there is 30 minutes of physical jerks at some period during the day. The hours are staggered to economise in training personnel. There is also one half-day devoted to games in addition to one clear day off in seven.

Whatever trade is being taught, the same system applies. Basic principles are gone into thoroughly, and a certain amount of practice is given. Experience is gained after posting to an operational unit where they work under the watchful eye of senior N.C.O.s, many of whom are peace-time-trained Halton boys. Even tradesmen who are following a closely allied trade to that pursued in civilian life admit that they learn a lot from this thorough delving into fundamentals. An added advantage of this training is that a man can turn his hand to any branch of his trade and not be circumscribed, as is usually the case in commercial life where repetition work is always at a premium.

Fitter-armourers (gun) assembling a power-operated turret.

Skilled Workmen

Bearing this out a motor cyclist's course lasts for a short period during which the pupil is taught how to remain in the saddle and do simple running repairs. On the other hand, a blacksmith or coppersmith is under instruction for what must seem a long while. It is actually a longer period than that devoted to a fitter-armourer, who has a complicated gun turret to look after. The reason is quite sound. Machine shop practice to-day works to such fine limits, plus or minus a five-thousandth of an inch is quite ordinary, that fitting in the sense originally applied is almost non-existent. The smiths, however (tin, copper, or black), are still as highly skilled jobs as in the days of horse-shoes and wrought-iron gates.

If any proof of skill attained were required, the beautiful wrought-iron altar rails which have been made by the trainees for the Roman Catholic church in the camp dispel all doubt.

(Above) In one of many blacksmiths' shops where a high standard of training is given.

Digressing for a moment to the subject of churches, of which the camp boasts three, Catholic, Church of England, and one for Other Denominations, the last two have had pulpits made for their padres out of the bows of two Vickers Walruses which were sent to the station to be hacked to pieces for salvage and instructional parts.

There is no trade as foundry worker appearing in any Air Force list, but it is quite obvious that castings are wanted for training production. For this purpose a small foundry has been installed capable of making small sand castings. In addition, for other training equipment, a wood mill has also been equipped with modern machinery. In contrast, and to give some idea of how the trainees are made to work with the simplest tools, the sheet-metal workers have only guillotines, rollers, folders and a small jenny for flanging. All concave and convex surfaces have to be hand beaten—spinning is not allowed. Even what are called Metal Workers' Reputed Pints, in which we had beer in the mess (they hold what is known as a buyer's pint) are made on the station by hand.

Naturally the station is very pleased with all the useful things they produce. One example, of which hundreds are being turned out, is ammunition loading drums for the 20 mm. cannon on Beaufighters. These exercise the turners, fitters, sheet-metal workers and welders. Other work of which they are particularly proud is the making of special rehabilitation equipment for a local Aircrew Convalescent Depot. One of their specialities is a variable-stroke stationary bicycle exerciser on which the patient can start with a crank length of two or three inches. As the limb joints become freer this can be increased to the normal measurement. Another device is a variable-speed running machine where the patient takes most of his weight on two elbow pads and runs on a moving platform. Yet another is a device for exercising fingers and wrists which have become set by being in plaster for a long while. Even stairs with variable risers have been made. Compared with the last war the men's accommodation is quite equal to the standard then enjoyed by commissioned ranks. Each man or woman has a spring bed with three "biscuit" mattresses. A shelf and a small cabinet is also provided for personal belongings. Food is good and plentiful. It is cooked in well-appointed kitchens and served in clean surroundings.

This station is particularly fortunate in its commanding officer. The welfare of every man or woman on the station is his personal care. Tennis courts, ornamental ponds, gardens and vegetable plots are all laid out, and by the C.O.'s own personal efforts a cinema seat-

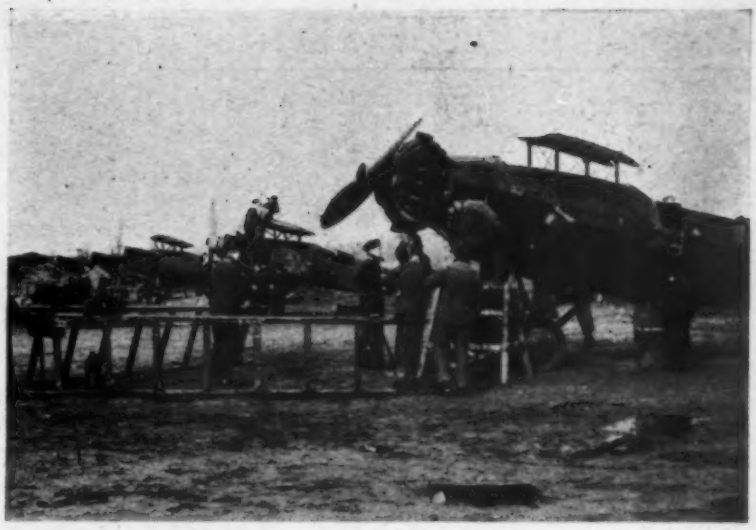
(Left) W.A.A.F. fabric workers at a theory class.

Practical work with a 20 mm. Hispano cannon at the stop butts.

TRAINING

ing 800 people has been built.- The barest shell of the building cost £4,000, but with two performances each night and three on Sundays it is already a paying concern.

Whenever Air Force mechanics are mentioned the mind immediately conjures up pictures of men tending aircraft and aircraft engines at dispersal points round a flying field. When it is remembered that operational flying fields on the various war fronts run into many hundreds—and this takes no account of training stations—it is not surprising that so many thousands of flight mechanics are required. They are being trained in huge numbers, but this does not mean that a mass-produced article is being turned out. The same system applies here as in other schools. Basic principles are taught first to the raw recruits—99 per cent. of them have no metal-working experience whatever when they arrive—and then they go on to actual aircraft components. To avoid confusion in the trainees' mind each unit, such as a brake system, or flap operation, is fixed up on a bench and powered by a small electric motor so that it can be demonstrated. After this has been explained and handled, a theoretical diagram is drawn on the blackboard. From these two the men make their notes for future reference. On the engine side Merlin, Pegasus, Mercury and Hercules are all available for instruction, in addition to American types which are coming into common use. For actual running instruction a number of D.H. Gipsy engines are used. These are erected and installed in Tiger Moths and then used for practice in starting light types.



(Above) Flight mechanics (engine) running up engines which they have installed in fuselages—mostly Wallaces.

(Right) Gun armourers fitting Brownings in a Spitfire.

Airscrews also receive a mead of instruction. Sectioned hubs of all the commonly used types are on hand, such as the two-position D.H., Rotol, D.H. Hydromatic and Curtiss Electric. They even have a Hele-Shaw Beacham (the forerunner of the Rotol) which was rescued from a scrap-heap.

After their final test the men are passed out as either flight mechanic (engine) or flight mechanic (airframe), and as such are posted to operational stations. At the stations a percentage of the best men are selected to return to the school to take a further course and qualify as Fitter IIA or Fitter IIE. These grades are considered to be the most highly skilled in the Service. On the men in them is the responsibility of declaring a machine to be serviceable.

Morse School

Other training establishments which have to think in terms of thousands are the Morse School, where butchers, bakers, candle-stick makers, or any other recruit learns to send and receive in the Morse code up to 12 words a minute. This is not, of course, the limit, but the required standard in the

A table in a Morse Signal school. Different speeds are practised at the various tables and a man progresses according to his ability.

TECHNICAL TRAINING

elementary stages. It is run rather in the manner of a progressive whist-drive. If the trainee is at a table where the standard set is six words a minute he stays there—within reason—until he reaches that speed. He then moves to the next table, where the speed is eight words a minute, and so on. The whole system is mildly competitive and keeps the fellows very keen. As soon as the requisite 12 words a minute is attained the recruit is posted away to another centre, where circuits and radio theory keep him fully occupied.

(Right) A naval sail-maker on the road to becoming a Fleet Air Arm fabric worker.

(Below) No matter what the trade, each man gets 30 minutes jerks once a day. This is not compulsory for men over 35.

Photography

To visit one of the schools of photography is to go from hundreds to dozens. Here W.A.A.F.s are learning to handle air cameras and process the films brought back by our pilots. Here, again, the elementary training deals almost entirely with basic principles. Later stages include enlarging, cine and miniature camera work in the air-conditioned mobile darkroom trailers (which are used in the field), and finally map-making with photographic mosaics. According to how well they pass their trade test pupils are sent to operational stations as aircraftwoman I, aircraftwoman II, or leading aircraftwoman I.

A very interesting school of training is one at which Poles are trained for ground and air duties. Language is the biggest problem, but this is being tackled in an ingenious fashion. During the early stages of training, Polish instructors use English terms when explaining aircraft parts. Through the same period the men attend English lessons, and so they understand a good deal by the time the English instructors take over for the more specialised subjects. All theory is given in Polish—all practical work is in English. The instructors are very enthusiastic about their charges. Apparently the biggest trouble is that all of them want to be air crew personnel in order to have a crack at the Hun, and none of them can possess himself in patience until he is trained.

Doubtless they will not have to wait very long before their wishes come true.

March Past during the C.O.'s parade at a Technical Training School.

ENGINEER'S TRIBUTE TO TECHNICAL PRESS

Mr. John Pascoe Appraises Work of British Technical Journals

A GENEROUS tribute to the work of the technical Press in this country was paid by Mr. John Pascoe, B.A., Deputy Chairman of British Timken, Limited, at a luncheon arranged at the Savoy Hotel, London, on December 1st. Normally the gathering would have been in celebration of the 21st anniversary of the Timken Company, but Mr. Pascoe devoted the occasion, after a survey of the growth of his great company, to a special acknowledgment of the co-operation his firm had enjoyed with the technical Press.

As an engineer his tribute to the work of the technical Press was a handsome one. He submitted that technical journals were performing a very real and vital service to the industry of this country. All new ideas in production, he emphasised, were truthfully and faithfully recorded by writers expert in their subject, and the pages of the technical journals constituted a meeting place for study and interchange of the views of practical engineers. Sufficient meetings to disseminate similar data would be quite impossible of arrangement, particularly in wartime, so that technical journals fulfilled a most important service. He urged that the Government should give more assistance and greater encouragement to the technical Press and mentioned his dismay at the proposal that the normal requirement of British technical journals in the matter of paper were not to be satisfied. The danger of losing experienced personnel was also an anxiety, and he wondered how industry could carry on if specialised journals were deprived of their skilled staffs. Each copy, he said, is nearly always read by a dozen executives, sometimes by many more. In the case of the British Timken works some journals are read by as many as thirty people. They are kept for more than a year and are constantly referred to during that period. Is there any better national service than that in the nation's fight for production, he asked.

Mr. John Pascoe, as Deputy Chairman, was speaking in the absence of the Chairman, Mr. Michael Dewar, who is in America on work for the Government.

Mr. Pascoe's tribute is most refreshing and encouraging to an important section of the publishing world, whose work under handicaps and difficulties in view of the war has evoked great appreciation, but none so pointed as that of Mr. Pascoe.

Some score of people prominent in the technical publishing world, representing 100 journals, attended the luncheon. Acknowledgment of Mr. Pascoe's tribute was made by Mr. Percival Marshall, Executive Chairman of the Periodical Trade Press and Weekly Newspaper Proprietors Association, and other speakers included Mr. G. Geoffrey Smith, Mr. J. A. Barrington Hooper, Mr. R. W. Hughman, Mr. Roland Dangerfield, Mr. J. A. Dixon and Mr. C. Edgar Allen.

MR. WINANT AT R.Ae.C.

THE American Ambassador, Mr. Winant, honoured the Royal Aero Club by meeting its members at lunch last week. In introducing Mr. Winant, Sir Francis McClean, chairman of the R.Ae.C., recalled that he was a pilot in the last war, as well as the present American Air Attache, General Royce.

Mr. Winant raised a laugh (the first of many) by pointing out that Sir Francis McClean actually started the first Lease-Lend act by presenting to the Royal Navy three machines on which the first Navy pilots learned to fly. Recalling his own early flying days, he said that at one time he held the unenviable record of having broken more "ships" than any officer in the American services, and someone had worked out that he would have to work for nothing for the American Government for the rest of his life in order to pay for the damage. Of our Minister for Aircraft Production Mr. Winant said that he honoured him particularly for holding pilot's certificate No. 1. That was the nearest thing to greatness.

In the present war America was taking full advantage of Great Britain's war experience, and was doing its best to apply it without lag. He recalled that in the war 1914-18 American aircraft did not get to the front until September, 1918. This time they had not been so slow, and had got their aircraft into the war fairly early. He paid a tribute to Great Britain for being pioneers of new types of military aircraft in peacetime.

Lt. Col. Moore-Brabazon expressed to Mr. Winant the gratitude of the Royal Aero Club for finding time to take lunch with the members. The R.Ae.C. was the pioneer aero club, and nobody had ever been keener on fostering and encouraging development. It was his task to look after aircraft production and also the co-ordination of our own and America's under the Lease-Lend Act. He had a sincere love and admiration for America and its great President, and no man was better fitted to represent the United States that Mr. Winant. Mr. Roosevelt had shown fine judgment in choosing him.

AN AMERICAN OPINION

British Efficiency Impresses a New York Publisher: But He Believes Bombs Will Win the War

AFTER a five weeks' study of air production in Great Britain, Mr. William B. Ziff, president of the Ziff Davis Publishing Co., of New York and Chicago, who has just returned to the United States, expresses his favourable impression of our efforts, voiced the opinion that the war was going to be won by bombs and added:

"I do not think the United States effort goes far enough. To my mind, the time has come when the U.S. Air Force should actually be based in your country.

"We cannot take a chance of Hitler winning. He represents a phenomenon new to mankind and will stop at nothing. Neither Britain nor America can beat him alone, and we must be ready for the time when he transfers the whole of his air effort to the subjugation of Britain. An attack on this country is eventually inevitable. Hitler must try it, whatever the losses."

One of Mr. Ziff's numerous magazines is *Popular Aviation*, and he served in the last war with the 202nd Air Squadron of the U.S. Army.

"Apart from the splendid work you are doing in regard to production," he said just before he left, "two things have particularly impressed me. One is the enormous amount you are saving on salvage operations. I have been frankly astonished at the thoroughness with which engines and parts which normally would be thrown away are being reclaimed by highly efficient methods. The other thing is the successful way in which the airfields are camouflaged. More than once the camouflage completely deceived me.

"It has been very instructive to examine your fighters. When one does so, it becomes easy to understand why they should be so superior to anything the Germans have. Some fascinating work is going on now in regard to engines, and it does seem as if performance in this respect is going to be limited only by the human element.

"That is particularly true of height, for with only a two-stage supercharger 45,000 ft. or possibly 50,000 can be looked upon as a practical possibility.

"In your bombers you have certainly demonstrated what can be done in the way of load-carrying, but so far we have not got withing talking distance of maximum efficiency in bombing. When we do, the Germans will wish they had never started the trouble.

"This war, in my opinion, is going to be won by bombs, which will reach a terrific size with a weight that may be up to ten tons. Bombs are going to be far more powerful than anything yet discussed. When they explode, the effects will be something much more than the blowing up of buildings and a few people near by. Over a huge radius all human beings will have their lungs burst and their eardrums shattered by the concussion.

"That is an appalling prospect, but it must be seriously contemplated. Britain has bombed the enemy on a very considerable scale and important results have been achieved; but if this war is not to go on for twenty years, there must be a much higher concentration of attack. Instead of tantalising German cities you have to obliterate them completely, for only by that method will the Nazis be made to realise the hopelessness of their position.

"There must be a call on all the flying men of every country that hates Hitlerism. Obviously that includes America."

AIRCRAFT CARRIERS in the PACIFIC

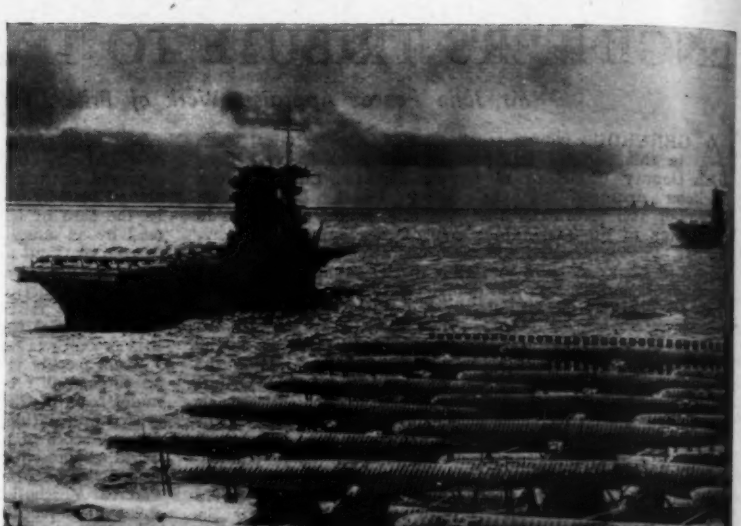
Comparative Strengths of the United States and Imperial Japanese Navies

IN the wide seas of the Pacific Ocean, with naval bases of both sides established on small islands hundreds of miles apart, the aircraft carrier as a naval weapon is having its first real test under ideal conditions. Most of our carrier engagements to date have been in the narrow seas within reach of short based aircraft. This has cramped their style to some considerable extent but, strangely enough, neither *Courageous, Glorious* nor *Ark Royal* was sunk by bombs.

Both the United States and the Japanese navies are strong in aircraft carrier tonnage and doubtless both nations are building others. America has in commission *U.S.S. Langley, Lexington, Saratoga, Ranger, Enterprise, Yorktown, Wasp* and *Hornet*. Little is known of the last two except that the *Wasp* has a tonnage of 14,700 and an extreme length of 688ft. The Hornet is a new ship of 20,000 tons.

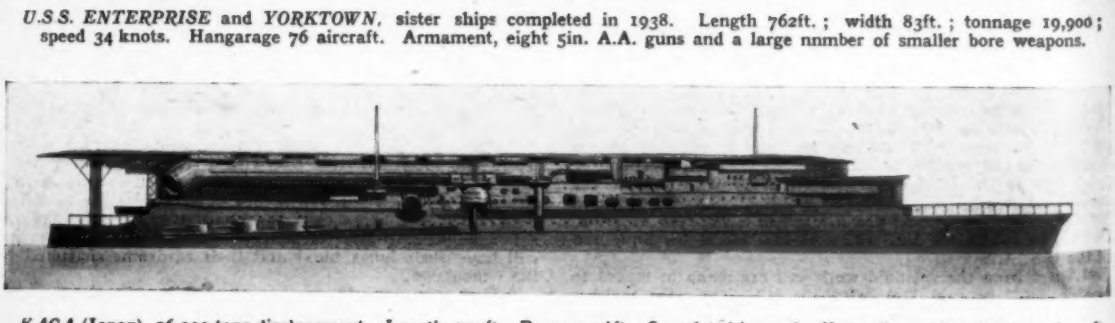
Japan has already in operation the *Kaga* and *Akagi*, each of 26,900 tons, two small ships *Hesho* and *Ryujo* of a little over 7,000 tons each, and a further three, *Soryu, Hinyu* and *Koryu*, all of the same class of 10,050 tons. It is probable that the Japs also have a further two ships in commission.

The United States navy has followed our basic design and all their carriers, with the exception of one, have control "islands" on the star-

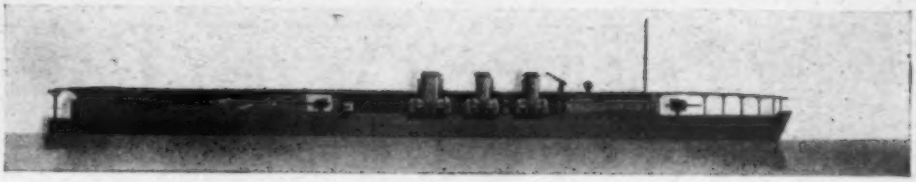


***U.S.S. SARATOGA* and *LEXINGTON* seen from the flight deck of the *RANGER*. They are sister ships of 33,000 tons and carry 80 aircraft each. Length 880ft., width 105½ft. Speed 34 knots. Complement 1,670 men. Armament comprises eight 8in., twelve 5in. A.A., four 6-pdr. and twelve machine guns.**

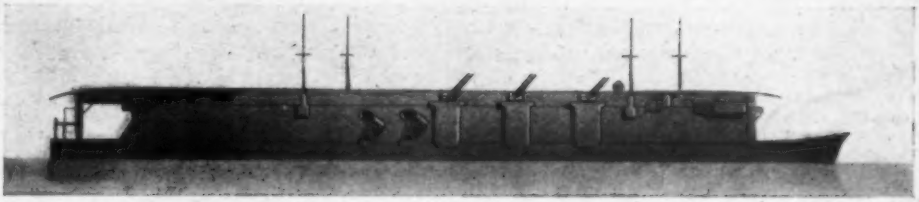
***U.S.S. ENTERPRISE* and *YORKTOWN*, sister ships completed in 1938. Length 762ft.; width 83ft.; tonnage 19,900; speed 34 knots. Hangarage 76 aircraft. Armament, eight 5in. A.A. guns and a large nnmber of smaller bore weapons.**



***KAGA* (Japan), 26,900 tons displacement. Length, 715ft. Beam 102½ft. Completed in 1928. Normally carries about 30 aircraft but has accommodation for a further 30. Armament, ten 8in., sixteen 4.7 A.A. and smaller weapons.**



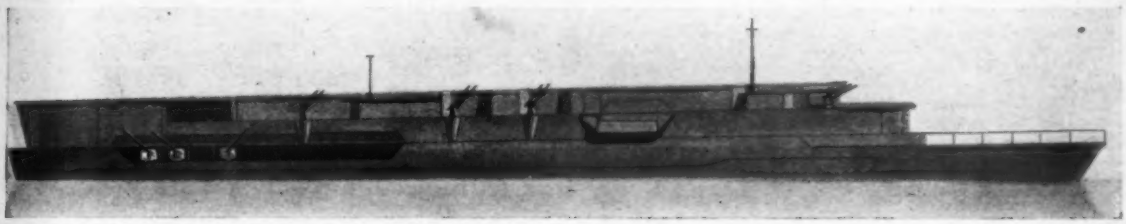
HOSHO (Japan) 7,470 tons. Length 510ft. Beam 62ft. Speed 25 knots. 26 aircraft. Armament, four 5.5in., two 3in. A.A. and smaller weapons.



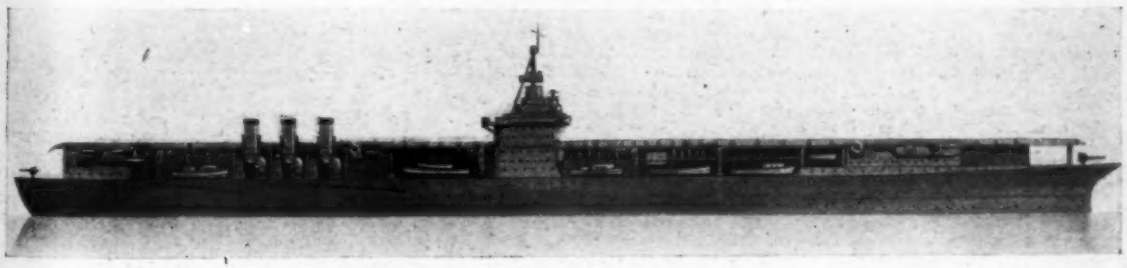
RYUJO (Japan), 7,100 tons. Length 548ft. Beam 70ft. Speed 25 knots. 24 aircraft. Armament twelve 5.1in. guns and a number of light and heavy high-angle guns.

board side of the flight deck. The exception, the *Langley*, was converted from the collier *Jupiter* in 1922. It has a length of 625ft. and a beam of 65ft. The strange outlines led to her becoming nicknamed the Covered Wagon. It was one of the first carriers to have arrester gear fitted in the form of athwartship wires with weights on the ends. As is common practice now, these wires were picked up by a hook hanging from the fuselage. To keep the aircraft running straight, fore-and-aft wires were engaged in fittings on the undercarriage axle. In addition, to make sure that a machine did not overshoot, a barrier of two heavy cables was stretched across the forward end of the deck about four feet high. The Japanese have favoured the flush deck scheme. Their smoke stacks are either carried aft under the flight deck or hinged to lie outboard during flying operations.

Despite the big tonnage of *Kaga* and *Akagi*—26,900 tons each—neither of them carry as many aircraft as do *Enterprise*, *Yorktown* or *Ranger*. Each of these Americans carry 76 aircraft for a tonnage of 19,900 for the first two and only 14,500 of the *Ranger*. *Kaga* is credited with 60 aircraft and *Akagi* with 10 less.



AKAGI (Japan), 26,900 tons. Length 763ft. Beam 92ft. Speed 28 knots. Hangarage for 50 aircraft. Armament, ten 8in., twelve 4.7in. A.A. and a number of smaller high-angle weapons.



U.S.S. RANGER, 14,500 tons. Length 769ft. Beam 80ft. Completed in 1934. Speed 29 knots. Armament, eight 5in. high-angle guns and about 50 smaller pieces. Carries 76 aircraft.

In addition to the carriers in commission and building the United States are converting a number of fast freighters. One of these, the *Mormacmail*, has a length of 492ft., a speed of 16½ knots, and a range of 14,500 miles. Hangarage for 30 aircraft is provided. Carriers of this type would be almost ideal for convoying merchantmen, but quite useless in a naval action.

Capital ships and cruisers on both sides are equipped with catapults and reconnaissance machines. Most of the American ships carry two catapults, and some of their cruisers have four aircraft available. As aircraft tenders the U.S. Navy has *U.S.S. Patoka*, 16,800 tons; *Heron*, 950 tons; *Jason*, 19,250 tons; *Aroostook*, 4,950 tons. There is also a repair ship, *U.S.S. Wright*, 9,553 tons, with accommodation for 27 machines. Japan also has a number of seaplane tenders. They are the *Kanoi*, 17,000 tons, 10 seaplanes; *Notoro*, 14,050 tons, 16 seaplanes; *Taigei*, 10,000 tons, 3 seaplanes; and the *Chitose*, *Chioda* and *Mizuo*, which are 9,000-ton vessels all of the same class.

When considering the strength of the opposing sides in this new battle of the Pacific it must not be forgotten that we weight the balance very heavily with our Far East Battle Fleet. It is to be expected that our naval force in that area is not devoid of aircraft carriers.

As we go to press reports from the Far East say that one of the Japanese carriers has been sunk, but the ship's name has not been given.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

JET PROPULSION OF AIRCRAFT

Different Principles Involved

YOUR correspondent, Mr. Martin G. Fernie, makes some surprising deductions from very uncertain premises and, as a result, arrives at conclusions which are contrary to logic.

A rocket working in atmosphere is less efficient than it would be *in vacuo* for two reasons. (1) Head resistance. (2) The friction of the emitted gases against the surrounding atmosphere causes back pressure, thus decreasing the expansion ratio of the gases.

There is no reason to suppose the gases which have been emitted at high velocity, possibly as great as 2.5 kms./sec., should return to, or cling round, the body of the rocket, and if they did, what about it?

Unless my appreciation of the principles of jet propulsion is entirely at fault, there is very little connection between jet propulsion and rocket propulsion. Jet reaction is simply another way of doing work, obtained by the combustion of the fuel, on the surrounding atmosphere. Rocket propulsion depends upon the evolution of gases at high temperature and the conversion of that heat energy into kinetic energy by expansion, and, apart from frictional losses in air, is independent of it.

It may interest Mr. Fernie to know that such a society as he speaks of has been in existence in this country for over two years, and although we have not been endowed with quite the galaxy of talented persons or the financial and other advantages he speaks of, we have succeeded in doing quite a lot of ordered research and experiment which will in due course assist the achievement of a better and more widespread understanding of the problems of rocket flight.

R. A. SMITH
(Organising Secretary, British Interplanetary Society).

Six Different Classifications

I BEG leave to amplify my recent letter, which you have kindly printed, stating that the propulsive effort of a simple rocket is less in atmospheric pressure. Not only does this pressure directly oppose the expansion of the fuels into the discharge gases, but the escape of these gases from the combustion chamber requires a greater pressure when the forward motion of the rocket is impeded by air resistance.

While there seems to be some agreement that there are two main kinds of jet propulsion, yet the bases of classification differ. It may help to consider six sub-divisions: (1) Mass of air mechanically accelerated by airscrew; (2) Supercharger augmenting mass of exhaust from petrol combustion, besides providing air for the combustion; (3) Exhaust from combustion augmented by aspirating air by means of a series of Venturi funnels; (4) Liquid oxygen and fuel, discharging gases directly from combustion chamber; (5) Powdered chemicals not requiring additional oxygen and discharging directly from container; (6) Cellular rocket developed by British Interplanetary Society.

Now, (1) to (3) are suitable for use in atmosphere and (4) to (6) *in vacuo*, but (3) may function with self-contained oxygen without becoming practicable *in vacuo*. Consequently, the best bases for classification seem to be, on the one hand, the mass of discharge at slow speeds in atmosphere and, on the other hand, the speed of discharge at high speeds *in vacuo*.

The view that known fuels are not powerful enough to provide escape from the Earth's gravitation springs chiefly from a repugnance to pay the necessary price of jettisoning fuel containers, which arises from the enormous fuel space ratio. The Cellular Rocket is designed to pay this price, and an initial weight of 1,000 tons would dwindle to 10 tons long before the end of a return trip to the moon.

The "cellular" design permits the control of the combustion of such an enormous store of fuel by electrically firing hundreds of rocket cells whose cases are then jettisoned. An incidental but important advantage is that by slightly inclining the longitudinal axes of the cells the aircraft may be made to rotate at a constant rate, not only providing directional stability, but also a radial acceleration which may be arranged to simulate convenient gravitational conditions for the occupants. All external observations would be made by means of synchronised rotating mirrors. R. C. ABEL, A.F.R.Ae.S.

FIGHTER DESIGN

Suggested Lay-out Criticised

THERE are a few details in the fighter design proposed by Mr. Taylor in your issue of November 27 which are at fault.

The unorthodox position of the airscrew renders the tail most vulnerable; attack from behind would probably destroy both control surfaces and propulsion. Thus the aircraft is severely handicapped in attack from any direction, since the designer himself has condemned the plane for dealing with bombers, in view of the lack of forward armament.

Your correspondent suggested that more orthodox types should attack bombers, but surely organisation difficulties will not always allow suitable types to be available at the right moment. After all, one cannot hope to be able to intercept with the right combinations during a regular blitzkrieg, and under such conditions the usual all-round fighters would be more useful.

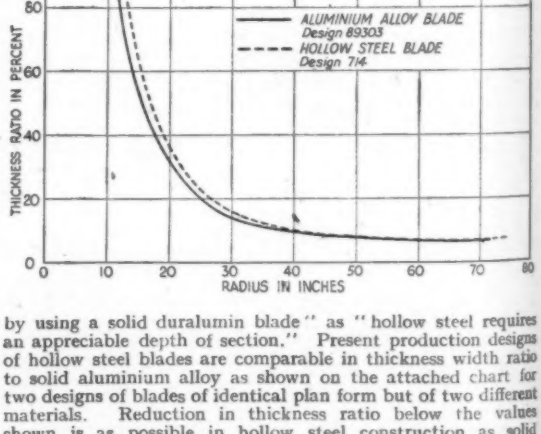
When on the ground, the aircraft offers little clearance under the propeller arc, and I should like to meet a pilot who would guarantee to land this type, time after time, without ever hitting his propeller. Also, some consideration has to be given to springing.

I am surprised that Mr. Taylor has neglected to employ in his design that cause of so much controversy—the contra-rotating airscrew! ROY T. SMITH.

AIRSCREW BLADE MATERIALS

Experience in America

WITH reference to Mr. K. B. Gillmore's interesting and thorough article, "Airscrew Blade Materials," in the September 18th, 1941, issue of *Flight*, our experience in the design and manufacture of both aluminium alloy and hollow steel blades does not bear out Mr. Gillmore's statement that "the highest efficiency at maximum speed will be obtained



by using a solid duralumin blade" as "hollow steel requires an appreciable depth of section." Present production designs of hollow steel blades are comparable in thickness width ratio to solid aluminium alloy as shown on the attached chart for two designs of blades of identical plan form but of two different materials. Reduction in thickness ratio below the values shown is as possible in hollow steel construction as solid aluminium alloy, and in fact for equivalent rigidity, a thinner section in steel can be used because of the higher modulus of elasticity—30×10^6 for steel as compared to 10.5×10^6 for aluminium alloy.

We would also like to refute Mr. Gillmore's statement that repair of hollow steel blades is impracticable. It is true that the percentage of blades now being repaired is less at present than aluminium alloy blades, but it is also true that a substantial percentage of damaged steel blades are repairable with present methods and that this percentage will increase as the technique for repair continues to develop. In this connection,

Mr. Gillmore's statement concerning the percentage of De Havilland blades which are returned to service after repair is thought to be rather misleading in that it implies that 80 per cent. of all damaged blades are repairable. It is the writer's understanding that crashed blades which are obviously not repairable are not returned to the manufacturer at all.

Mr. Gillmore's conclusion that the solid aluminium alloy blade is the only one for wartime use is no doubt logical from his standpoint in view of the fact that a successful hollow steel blade has not as yet been developed by his firm. However, experience has shown that a hollow steel blade propeller is lighter than its dural equivalent, particularly in the larger sizes, which will make for more efficient aircraft.

Furthermore, the greater resistance to abrasion of the steel blade will assist in making practicable such aircraft types as pushers, close-coupled tricycle landing gear designs, etc., which would otherwise be handicapped by short blade life. therefore, it seems to the writer that steel blades are very definitely needed in order to maintain superiority in aircraft performance.

GEORGE W. BRADY
Chief Engineer, Curtiss-Wright Corporation (Curtiss Propeller Division).

PROPAGANDA POLICY

British and American Aircraft

LATELY there has been so much talk in official communiqués of the part played in the fighting by Dominion and Allied troops that every now and then a Government spokesman feels it necessary to quote figures to prove that men from the United Kingdom are actually doing most of the work and suffering the heaviest casualties. A somewhat similar process can be noticed in the repeated mentions in communiqués of the work done by American aircraft.

We are all, of course, immensely gratified to receive many excellent types from the United States, but such propaganda may perhaps defeat its own object if the Americans are led to believe that we British are not turning out great numbers of excellent machines ourselves.

I believe that the Americans really want to know that Britain is actually depending chiefly on her own production, and that her native types are quite as good as the American ones, and sometimes better. It was refreshing to read the other day that an American authority said that Britain had set American industry a very hot pace.

IMPERIALIST.

BOOK REVIEWS

"Thy Muse Hath Wings." By P/O. G. Eades; Pen-in-Hand Publishing Co., Ltd., Oxford. 3s. 6d.

A Pilot, very young, there was
Who once took up his pen because
He wanted to describe the things
He'd felt since he acquired his wings,
In verse.

Some thirty pages has he filled
With verses not a little skilled;
So good, in fact, that should we write
In rhyme, we greatly fear we might
Do worse.

So if (as poets do sometimes)
He doubts the value of his rhymes,
And fears his halting Muse is ill-
Equipped adequately to fill
His purse.

Then earnestly we pray the bloke'll
Not dismally invade the local,
And after drinking many beers
Know not if to dissolve in tears
Or curse.

For we, reviewing what he wrote,
Accord to it a thumbs-up vote;
Since our opinions, he should know,
Would bear to his a ratio
Inverse.

"How the R.A.F. Works." By A. H. Narracott, Air Correspondent of "The Times." With a Foreword by the Rt. Hon. Sir Archibald Sinclair, Secretary of State for Air. (Frederick Muller, Ltd., 5s. net.)

IN a previous book Mr. Narracott admitted that in September, 1939, he knew "next to nothing" about the R.A.F. Now he knows a great deal about the subject, though how he has learnt so much in so short a time is quite astonishing. In his present book he imparts his knowledge to the general reader, and he is a reliable guide. Perhaps it is natural that the history of the Air Force should not be his strongest point, and the chapter entitled "Introduction," which deals with that subject, is not entirely accurate. But with the R.A.F. as it exists to-day Mr. Narracott is quite up to date, and gives a very good description of the work of the various Commands.

Elementary Navigation for Air Training. By C. Barrington Gyford, B.Sc. (Longmans.) 1s.

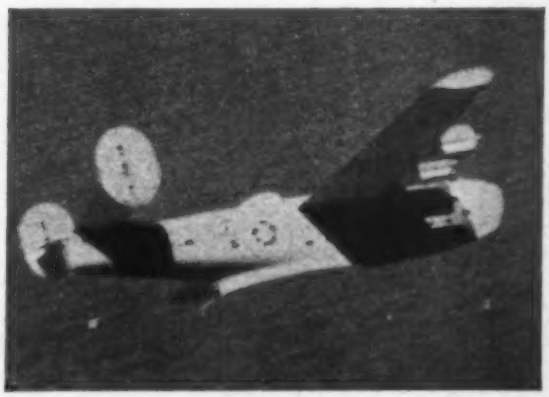
THIS little booklet, which makes only the most modest demands on the student's mathematical knowledge, covers the syllabus in navigation issued by the Air Ministry for the pre-entry training of A.T.C. cadets. Like a similar publication by another author on the same subject, recently reviewed in *Flight*, it begins at the beginning by explaining about latitude and longitude and how these measurements are shown on the flat surface of a map. The use of the magnetic compass follows, with its practical application to course plotting, after which the student is introduced to the triangle of velocities and wind drift. Room has also been found within its 48 pages for brief chapters on the air-speed indicator and the altimeter, some useful observations on wind characteristics and a table of conventional map signs.

SAILORS WITH WINGS

ALTHOUGH it runs for only about 20 minutes, the March of Time film, "Sailors With Wings," gives an instructive insight into the development of the U.S. Naval Air Service and its present big part in the Battle of the Atlantic. From early experiments in naval aviation—dating back to 1910—it traces briefly the progress through the intervening years, and there are some admirable shots of torpedo-bombers and dive-bombers at practice, including some exhilarating exhibitions of the "peel-off" from line abreast formations, catapult launches and deck take-offs from modern aircraft carriers.

Catalinas and the four-engined PB2Y patrol bombers are also seen ranging over the ocean in protective operations against possible Axis submarines or surface raiders, and for a few moments one flies with the crew in one of these "big ships" as the Yankees affectionately call them.

The administrative and training aspects of the U.S. Naval Air Service is not overlooked and the running commentary is interspersed here and there with brief intervals of dialogue. This film gives a very fair demonstration of the interdependence of sea and air power.



A Consolidated PB2Y of the U.S. Navy on Atlantic patrol.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

IMMEDIATE AWARD OF THE DISTINGUISHED SERVICE ORDER.

Wing Cdr. P. JEFFREY, D.F.C., R.A.A.F.—Wing Cdr. Jeffrey has won the D.S.O. not only for his bravery and personal exploits, but for his qualities of leadership. Since the recent offensive began he walked back to our territory after being shot down by the enemy. He won the D.F.C. in the spring of this year, when he brought his squadron back from Benina to Egypt under the most trying conditions. He retained his command of the squadron until just prior to this offensive, when, instead of returning to Australia, as first intended, to take up a staff appointment, he was made wing leader (flying) of a fighter wing.

DISTINGUISHED SERVICE ORDER.

Wing Cdr. F. S. STAPLETON, D.F.C.—Since June, 1941, this officer has participated in 47 operational sorties. Leading the wing with the utmost coolness and determination, he has taken every opportunity to support the formations and to inflict damage on the enemy. Since being awarded the D.F.C. he has destroyed 4 enemy aircraft and has probably destroyed or damaged several others.

Act. Wing Cdr. A. H. BOYD, D.F.C., R.A.F.O.—Since August, 1941, this officer has led the wing on numerous occasions greatly distinguishing himself throughout. His excellent leadership and tactical ability have been of great value when difficulties have been encountered. Wing Cdr. Boyd has destroyed at least 16 enemy aircraft.

Act. Wing Cdr. J. RANKIN, D.F.C., R.A.F.O.—Since the end of August, 1941, this officer has participated in 21 operational sorties, in which he has destroyed 5 hostile aircraft. This brings his total victories to 18 destroyed. He has probably destroyed or damaged a number of others. He is an outstanding wing leader who has displayed exceptional ability, determination and courage on all occasions.

Sqn. Ldr. J. NESBITT-DUFORT, No. 138 Squadron.—This officer has carried out 16 operational sorties over enemy territory, involving attacks on aerodromes as well as other flights of extreme importance. His skill, determination and courage have been of the highest order.

DISTINGUISHED FLYING CROSS.

P/O. D. F. H. BIGGANE, R.A.F.V.R., No. 408 (R.C.A.F.) Squadron.—One night in November, 1941, this officer was the pilot of an aircraft which carried out a mine-laying mission in waters near the enemy coast. Extremely adverse weather conditions were encountered whilst flying over the sea, and, when the target area was reached, very heavy clouds were encountered. Nevertheless, P/O. Biggane descended beneath them and skilfully located his position.

Whilst making his approach to the target his aircraft was illuminated by searchlights, and immediately subjected to intense and accurate fire from two armed ships. Defying this barrage, P/O. Biggane continued his course, and, although his aircraft received a direct hit on one of the wings, he skilfully accomplished his task.

This officer has completed many operational sorties, including attacks on important targets in Germany. On one occasion, whilst flying to Mannheim, his aircraft was attacked by two enemy fighters whilst held in a concentration of searchlights, but, although his aircraft sustained damage, P/O. Biggane skilfully evaded his attackers, continued his flight, and finally bombed his objective.

On a second occasion, in the course of another mission, he attacked two ships, scoring a direct hit on one of them from a low level.

Throughout, this officer has displayed great determination, courage and initiative.

Act. Sqn. Ldr. P. A. WOMERSLEY, A.A.F., No. 59 Squadron.—Act. Sqn. Ldr. Womersley has been employed on operational flying for over a year, and has carried out 90 sorties, including attacks on enemy ports, aerodromes, and shipping at Cherbourg, Boulogne, Lorient and Brest. On one occasion he scored a direct hit on an enemy ship off Dunkirk. He has displayed outstanding courage in the face of enemy opposition.

Flt. Lt. J. E. R. HAYTER, No. 240 Squadron.—Flt. Lt. Hayter has been continuously employed on operational flying since the war began, and has completed nearly 1,800 flying hours, often in bad weather, over the North Sea, the Western Approaches, and the Norwegian coast. Flt. Lt. Hayter has set an example which has been of the utmost value in maintaining the efficiency of the squadron.

IMMEDIATE AWARD OF THE DISTINGUISHED FLYING MEDAL.

The second decoration for gallantry in the air during the battle of Libya goes to Air Sgt. K. G. DU PRE, of the South African Air Force. As announced from headquarters, R.A.F., Middle East, he has been granted an immediate award of the Distinguished Flying Medal.

On November 20 the aircraft in which Sgt. du Pre was top gunner was attacked by enemy fighters near Tobruk.

The bottom gunner was hit by bullets and was slipping through the lower hatch when Sgt. du Pre went down and dragged him back to safety while the attack was still in progress.

Returning to his guns after caring for the wounded man, Sgt. du Pre kept up an effective fire until the mechanism jammed.

He then stayed at his post and kept the pilot informed of the movements and attacks of the enemy fighters.

DISTINGUISHED FLYING MEDAL.

Act. Flt. Sgt. G. E. A. PENDRILL, R.A.F.V.R., No. 97 Squadron.—One night in November, 1941, this airman was the captain of an aircraft which carried out a mine-laying operation in heavily defended waters. By sheer determination and devotion to duty, made in the face of adverse flying conditions, and despite intense anti-aircraft opposition, the task was successfully accomplished.

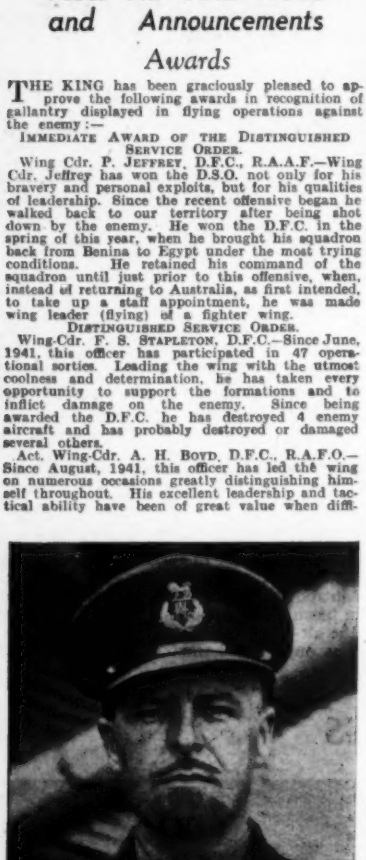
Two days later he attacked a target in the Rhineland, and on the return journey his aircraft was intercepted by an enemy fighter. Displaying great coolness, Flt. Sgt. Pendrill instructed his rear gunner to withhold his fire until the enemy flew into close range, when it was shot down and observed to crash and burst into flames. This airman has always shown the greatest courage in attacking his targets.

Sgt. R. W. DALTON, R.A.F.V.R., No. 604 Squadron.—This airman has displayed great skill in night operations. His enthusiasm and perseverance have set an excellent example.

Sgt. R. E. GILLMAN, No. 107 Squadron.—In November, 1941, this airman participated in a shipping sweep over the Ionian Sea. Two merchant vessels escorted by a destroyer were observed, and, despite intense fire from all three vessels, one of them was attacked at mast height. Sgt. Gillman pressed home his attack, and, although his aircraft was hit several times by shell-fire, he scored two direct hits on the ship, which caught fire and became enveloped in thick black smoke. This airman displayed great courage and determination throughout the attack.

Sgt. J. E. VAN SCHAICK, R.A.F.V.R., No. 609 Squadron.—Since July, 1941, this airman has participated in 50 operational sorties, and has proved himself to be a keen and reliable pilot. He has

SINGAPORE PARADE: Sir Shenton Thomas, Governor of the Straits Settlements, took the salute at a march-past after inspecting an R.A.F. "passing-out" parade at which he was accompanied by Air Vice Marshal Pulford. Sir Shenton is here seen inspecting the successful cadets.



Capt. O. P. Jones, veteran pilot (at the age of 43) of Imperial Airways and British Overseas Airways, who recently broke the West-East Atlantic record when he ferried a Liberator across in 8 hr. 23 min.

destroyed two, and probably destroyed or damaged several other hostile aircraft.

Sgt. H. G. MATTHEWS, No. 236 Squadron.—Sgt. Matthews was severely wounded in the left shoulder during a combat with two Heinkel 111s. Nevertheless, he continued to man his turret and during the return flight was continuously in wireless communication with his base. In this way he contributed largely to the safe return of his aircraft.

Flt. Sgt. R. L. SNELUS, No. 236 Squadron.

Roll of Honour

Casualty Communique No. 95.

THE Air Ministry regret to announce the following casualties on various dates. The next-of-kin have been informed.

Royal Air Force

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY.—Sgt. R. L. Aiken; Sgt. R. J. Hobbs; Sgt. N. F. Hunt; Sgt. R. G. Ilford; Sgt. A. F. G. Redwood; Sgt. R. A. Stansfield; Sgt. H. W. White.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. T. J. Baston, P/O. C. E. Crichton, Sgt. J. L. Evans; Sgt. D. J. F. Jefferis; P/O. E. F. Payne; Sgt. G. L. Tompson; Sgt. E. W. Tyler; Sgt. A. L. F. Webb.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. N. H. Andrew; Sgt. C. T. Chipperfield; P/O. C. Colebrook; Sgt. T. W. A. Crone; Sqn. Ldr. L. E. Cryer, D.F.C.; P/O. E. D. Dear; Sgt. A. P. Drane; F/O. J. Dunn; Flt. Sgt. R. Fitzpatrick; Sgt. T. R. Gaskell; Sgt. K. Gray; Sgt. W. D. Hughes; Sgt. H. Jones; P/O. M. W. Lishman; P/O. A. W. Martin; Sgt. G. C. Moore; F/O. T. L. Patterson; Sgt. N. B. Pell; Sgt. F. Stones; P/O. R. B. Webster; Flt. Sgt. C. R. Wells; Sgt. L. A. W. Wilkinson; F/O. H. M. Selwyn.

WOUNDED OR INJURED IN ACTION.—Sgt. D. L. Bennett; Sgt. R. D. Shackleton; Sgt. C. C. Stevens; Sgt. V. E. Tucker.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. S. W. J. Lamerton.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. R. Chapman; Sgt. P. F. Collis; Sgt. R. A. Dundon; Sgt. I. E. Griffin; Sgt. A. Hendy; Flt. Sgt. E. Moulding; P/O. K. E. A. Savage; Sgt. W. B. M. Smyth; Sgt. S. S. A. Symons; P/O. J. Unsworth, D.F.M.; Sgt. W. White; Act. Flt. Lt. J. R. Wilson; Sgt. W. P. Wright.

PREVIOUSLY REPORTED PRISONER OF WAR, NOW REPORTED MISSING, BELIEVED KILLED IN ACTION.—Sgt. G. E. Lang.

MISSING.—Sgt. R. B. Allport; Sgt. W. Alton; Sgt. J. Bendall; Act. F/O. C. O. Bloodworth; Sgt. P. F. Bold; Sgt. A. Brown; Flt. Sgt. W. F. P. Brown; P/O. H. B. Carroll; Flt. Sgt. J. S. Cooper; Sgt. G. T. Cox; Sgt. H. Crossley; Sgt. W. H. Cubbon; Sgt. H. E. Dance; Sgt. F. Garde; Sgt. H. C. Gardner; Sgt. R. G. Gove; Act. Wing Cdr. F. A. Harte, D.F.C.; Sgt. C. H. Hill; Sgt. S. Howarth; Flt. Lt. G. F. Irving; Sgt. T. G. Jones; Sgt P. Kay; Sgt. E. H. Keeping; Flt. Sgt. W. S. Kitson, D.F.M.; Sgt. C. C. Kolar; Sgt. J. W. Lee; Sgt. J. D. Life; Sgt. J. A. McDonough; Sgt. J. A. McLean; Sgt. F. Mason; F/O. M. J. Miller; P/O. L. A. J. Mills; P/O. W. G. Noble; Sgt. E. Owen; Sgt. J. R. Palmer; Sgt. R. Pinkerton; Sgt. W. J. Poole; Flt. Lt. F. C. Powles, D.F.C.; Sgt. R. A. G. Ragg; Sgt. C. R. Ramsay; P/O. J. F. Reeves; P/O. J. C. L. Rack-Keene; Sgt. G. Shearer; Sgt. J. C. Sherridan; Sgt. A. E. Smith; P/O. N. J. Smith; Sgt. J. Swan; Flt Sgt. F. A. Titcomb; Sgt. W. Trotter; Flt. Sgt. R. R. Walker; Sgt. R. L. Warburton; A/C.2 S. G. Watson; F/O. T. Wewege-Smith; Flt. Sgt. S. J. Williams; Sgt. R. M. C. Worthington.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION).—P/O. W. M. Bishop; P/O. J. R. Cox; P/O. H. H. Hay; P/O. F. J. Kruszynski; Flt. Lt. R. F. Leavitt, D.F.C.; Sgt. E. V. Message; Sgt. J. E. Stoddart.

KILLED ON ACTIVE SERVICE.—A/C.2 K. Adamson; Flt. Lt. J. C. Alexander; P/O. K. Alexander; Flt. Sgt. J. A. McK. Allison; Sgt. C. P. Allsop; A/C.1 H. Armitage; L.A/C. C. A. W. Baldwin; A/C.2 T. A. Berrill; Sqn. Ldr. J. C. Betts; Sgt. T. Blackburn; P/O. A. J. T. Boddam-Whetham; L.A/C. W. J. Brennan; Sgt. R. H. Brickett; A/C.1 R. T. M. Bullocke; Sgt. R. J. Chandos; P/O. L. A. Chatterton; P/O. N. J. Choppen; L.A/C. P. C. J. Colling; L.A/C. J. T. Costine; Sgt. E. M. G. Davies; P/O. J. D. Davis; L.A/C. J. H. G. D'Silva; P/O. K. Farnes; Sgt. C. H. Fletcher; Sgt. R. J. Gardner; L.A/C. W. S. E. Gianella; Sgt. W. D. Gilmour; Flt. Lt. D. I. Graham; F/O. C. H. Hall; Sgt. E. H. C. Hardman; Sgt. J. C. Hill; A/C.1 E. Hughes; A/C.2 P. B. Hunter; L.A/C. C. T. Jenkins; Sgt. R. C. D. Jones; Cpl. T. E. E. Leahy; P/O. L. B. Louden, Sgt. P. C. McCue; L.A/C. W. D. J. McLaughlin; L.A/C. P. C. May; P/O. C. H. Mills; Cpl. F. A. Mitchell; P/O. W. Mulhern; Sgt. G. Phillips; Sgt. A. Raw; P/O. J. A. Scroggie; Act. Flt. Lt. G. A. Steward, D.F.M.; Sgt. W. T. Strother; P/O. J. Turner; Sgt. F. P. Turton; L.A/C. W. C. Vocking; Sgt. H. Weir; Sgt. J. W. Welling; L.A/C. P. R. West; A/C.1 R. W. J. Winslade; Sgt. C. W. Woolgar.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. L. G. B. E. W. Bunker.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE—Sgt. J. B. Slack.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. L. Copland; Sgt. W. Donald; Sgt. E. J. Harrington; Sgt. F. B. Mitchell; Sgt. E. P. H. Peek; P/O. W. E. Steele; P/O. J. E. Taylor; Flt. Sgt. G. C. G. Warburton.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. A. T. Brooks; L.A/C. R. V. Castle; P/O. C. H. Hayes; Sgt. J. R. Jackson; Flt. Sgt. T. A. Maslen; Sgt. R. F. A. Young.

DIED ON ACTIVE SERVICE.—A/C.2 S. Assata; A/C.1 D. B. Brittain; A/C.2 C. W. Brown; Cpl. H. B. P. Burgin; A/C.2 W. C. Carter; A/C.2 T. McI. Dean; Act. Sqn. Ldr. P. D. Dear; L.A/C. G. A. Ford; A/C.2 J. Gerber; P/O. R. H. W. Horn; A/C.1 W. Lynch; Flt. Sgt. L. M. Keam; L.A/C. C. MacGregor; A/C.2 G. W. McLeod; A/C.2 D. R. Massey; A/C.2 P. E. Morrisey; A/C.2 M. Nyman; L.A/C. O. Rose; A/C.2 G. E. Smith; L.A/C. T. Southward; A/C.1 G. W. H. Stapleford; A/C.1 W. T. Walls; A/C.2 C. Woodward; Sgt. W. Yeomans.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. R. Chapman; Sgt. R. A. C. Hooper; L.A/C. E. Penniceard.

Royal Australian Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. Seacomb; P/O. E. J. Sugg.

MISSING.—Sgt. L. G. Faunt; Sgt. W. L. N. Johnston; Sgt. J. G. Merrett.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. A. G. White.

KILLED ON ACTIVE SERVICE.—Act. Sgt. T. H. Kelsall; Sgt. E. McCormack; Sgt. E. H. Mills; Sgt. N. W. Mowat.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—P/O. R. A. Malloch.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. A. T. McMillan; Sgt. D. D. Taylor.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. G. K. Coates.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. F. Dickson; Sgt. T. L. Duxbury; P/O. W. E. Simpson.

MISSING.—Sgt. G. H. Edmondson; Sgt. T. C. Fitzgerald; P/O. J. R. Freeland; Sgt. L. E. Dodge; Sgt. C. R. Hall; Sgt. L. H. Jackson; Sgt. J. L. Lockwood; P/O. G. S. McDonald; Sgt. G. F. Matt; P/O. H. S. Ray; Sgt. R. H. Toshack; Sgt. P. T. W. Walker.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. E. W. McFall.

KILLED ON ACTIVE SERVICE.—Sgt. D. J. Connolly; Sgt. R. B. James; Sgt. R. E. McMurry; Sgt. J. M. Maxon; Sgt. D. A. Neal; Sgt. G. G. Taylor.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. G. W. Gates.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. D. G. Bradley.

MISSING, BELIEVED KILLED IN ACTION.—P/O. I. M. V. Field; Sgt. H. C. McL. Haselden.

MISSING.—Sgt. D. A. Connolly; Sgt. L. L. Har-

MIND MY TRIKE! Bell Airacobras, with their tricycle undercarriages, are now in full operation with the R.A.F. Here is an impressive line-up at a station in England.

A TOI, MON AMI! The mess of the Free French Air Force in London is in a house in Westminster, given by the mother of the late F/O. John Rathbone, in his memory. An R.A.F. sergeant and a French fighter-pilot are here seen toasting to victory.

SERVICE AVIATION

rison; Sgt. A. I. Paget; Sgt. C. M. Thompson; Sgt. G. F. Williams.

KILLED ON ACTIVE SERVICE.—Sgt. H. L. Craw; Sgt. N. W. Thompson.

WOUNDED OR INJURED IN ACTION.—Sgt. B. C. McG. Harrington.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. C. H. Howard.

South African Air Force

KILLED ON ACTIVE SERVICE.—2/Lt. A. F. Quincy.

Casualty Communique No. 96

Royal Air Force

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. E. J. Beard; P/O. D. R. Bowden; Cpl. G. I. F. Davies; Sgt. V. J. Hale; Sgt. O. Halward; Flt. Sgt. H. Higginson; L.A/C. W. J. Lee; P/O. A. Lodge; Flt. Sgt. J. Menzies; Sgt. J. R. Northcote; Flt. Lt. A. J. Oettle, D.F.C.; Sgt. T. Phillips; L.A/C. C. Robson; P/O. H. R. Rowntree; Sgt. E. B. Smith; Flt. Sgt. D. Stable; Sgt. J. Walsh.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. D. R. Black; Sgt. P. J. Church; Sgt. F. A. Hatton; Sgt. A. F. Tweed; P/O. D. F. Walker; Sgt. E. E. Weldon.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. M. B. Appleby, P/O. W. E. Bowden; P/O. F. H. Cook; Sgt. B. M. Evans; P/O. J. W. Gadsby; Flt. Sgt. J. M. Irving; Sgt. J. G. MacIlwraith; Sgt. M. A. J. Savage; P/O. H. A. L. Stone.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. T. Robertson.

WOUNDED OR INJURED IN ACTION.—F/O. G. N Dawson; P/O. P. P. Godfrey; P/O. A. F. Roscoe; Sgt. J. M. F. Shilan; Sgt. P. F. Walker; Sgt. J. F. Whittaker.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. C. A. G. Clark.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. Barton; Sgt. R. C. Blamey; P/O. G. B. Buse; Sgt. H. E. Chamberlain; Sgt. J. Chapman; Sgt. R. H. G. Collins; Sgt. A. Y. Condie; P/O. K. T. Cooper; P/O. D. K. Fawkes; Sgt. K. S. Furley; Sgt. P. J. M. Hamilton; Sgt. A. H. Harman; Flt. Sgt. P. L. Hennigan, D.F.M.; Sgt. T. Jackson; Sgt. E. R. James; Sgt. E. G. Knight; P/O. W. Laidlaw; Sgt. J. A. Lamb; Sgt. S. J. L. Levack; F/O. P. C. Martin; Sgt. A. G. Palmer, D.F.M.; Sgt. A. J. K. Parratt; Sgt. F. E. Ridler; Sgt. W. A. Saunders; Sgt. A. W. Smith; Sgt. A. Stanier; Sgt. W. R. Steele; Sgt. P. F. Swain; Sgt. R. H. Tasker; Sgt. C. Taylor; Sgt. R. C. Tyrrell; Sgt. G. L. Wincott; Sgt. W. C. Wright.

MISSING.—Sgt. E. W. Andrews; Sgt. H. I. S. Armes; Sgt. R. H. Atkinson; Sgt. W. E. Austin; Sgt. F. A. Axe; Sgt. G. F. Bateman; Sgt. A. E. Belasco, Sgt. P. H. Bell; Sgt. S. Bentley; Sgt. A. L. Bradshaw; Sgt. J. I. Bramwell; P/O. L. W. Brown; P/O. W. H. Budd; Sgt. K. Carter; P/O. V. C. H. Colbourne; Sgt. F. Conley. P/O. A. E. Day; Sgt. R. W. Dunkley; Sgt. P. P. F. Dupre; Sgt. I. L. Evans; Sgt. H. F. Eyre; Sgt. J. Forrest; Sgt. E. Gillam; Sgt. R. A. Gladen; Sgt. G. C. P. Haines; Sgt. E. Haste; Sgt. E. W. Hawkins; Sgt. S. C. Hodge; Sgt. K. A. Holmes; Sgt. R. L. Hughes; Sgt. R. L. Hunt; Sgt. A. W. Jefferies; Sgt. F. Jenkins; Sgt. A. T. Laing; Sgt. D. R. Lake; Sgt. F. A. Lamb; Sgt. H. R. Legg; Sgt. C. A. V. Lyons; Sgt. W. McKelvie; Sgt. E. R. B. Magrath; Sgt. D. G. McG. Mayo; Sgt. P. A. Milton; Sgt. J. K. Mitchell; P/O. H. Mohr-Bell; Sgt. C. M. Morris; Sgt. E. W. Paine: Flt. Sgt. A. J. Park; Sgt. A. H. K. Pedley; Sgt. E. L. Phillips; Sgt. S. C. Ray; P/O. J. H. Richardson; P/O. J. Rollinson; Sgt. J. Shaw; Sgt. L. W. Shearing; Flt. Lt. A. J. C. Simpson, D.F.C.; P/O. E. G. Smith; P/O. P. H. Smith; Sgt. L. Stock; Sgt. B. R. Thomas; Sgt. B. D. Waghorn; Sgt. B. W. Wareham; Sgt. D. K. Warner; Sgt. C. A. Webster; Sgt. W. C. Wood; P/O. T. E. Wootton.

KILLED ON ACTIVE SERVICE.—L.A/C. A. J. Baker; Sgt. F. R. Bayliss; Sgt. E. J. Bush; L.A/C. H. V. G. Christopher; A/C.2 T. Clapperton; L.A/C. F. A. Coles; L.A/C. R. D. Connell; P/O. J. F. Deck; Sgt. K. J. Dierden; Sgt. W. A. S Doig; Sgt. R. G. G. Gain; A/C.1 T. A. Gray; Sgt. L. P. Griffin; L.A/C. G. W. Griffiths; Sgt. J. A. Hedley; Sgt. A. C. Hendry; Sgt. L. A. Hill. Cpl. D. R. Hodkinson; Sgt. C. V. Irish; L.A/C. H. R. Johnson; P/O. G. D. Kerr; L.A/C. K. A. Knudson; Sgt. G. N. Leadley; Flt. Sgt. C. E. Levitt; Sgt. J. E. Mears; Sgt. G. F. Neale; Sgt. R. H. Oakley; Sgt. H. Playforth; Sgt. J. Reid; P/O. J. F. Reid; Sgt. E. V. Sansom; P/O. A. T. Sims; Sgt. S. Slater; Sgt. D. Tatton; Sgt. H. W. Taylor; L.A/C. I. J. Urwin; P/O. R. M. Van Breda; Sgt. P. Walker; Cpl. N. A. White; Sgt. I. M. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. W. A. Crosswell.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. J. Barker; Sgt. W. A. Beadle; Sgt. C. M. Faircliffe; F/O. B. L. Howell; Sgt. J. W. Walters.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. H. A. Nicholson; L.A/C W. C. Thompson.

DIED ON ACTIVE SERVICE.—Sqn. Ldr. W. J Allingham; A/C.2 H. F. Barnes; A/C.2 H. T. Burden; Cpl. N. G. Darrah; A/C.2 N. R. Gerrish; L.A/C. P. G. Hills; Sgt. J. J. Kavanagh, D.F.M.; Cpl. H. A. Leiper; A/C.2 G. Macdonald; A/C.1 E. W. Marsh; Cpl. D. C. Simpson; Cpl. R. Stewart; P/O. C. R. Stokes; L.A/C. F. Tufft; L.A/C. N. K. W. Taylor; A/C.2 T. J. Tupper

Act. Wing Cdr. James Rankin, D.F.C., who has now been awarded the D.S.O. He has a total bag of 18 enemy aircraft, five of which he has brought down since August.

"MET" RECORD: This 32-year-old Flt. Lt. of R.A.F. Coastal Command, who collects "pukka gen" about the weather from "upstairs," has now completed 849 meteorological flights in a single-seater fighter. This snap was taken just before he took off for the 849th.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. T. D. Parker.

WOUNDED OR INJURED IN ACTION.—Sgt. H. W. Shaper.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. P. G. Crittenden; Sgt. L. M. Rendett; Sgt. J. Roberts.

MISSING.—P/O. B. B. Barber; Sgt. C. Cassell; Sgt. B. P Hoad; Sgt. T. Taranto; Sgt. R. H. Wilson.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. J. E. Hiller.

KILLED ON ACTIVE SERVICE.—Sgt. J. S. Gillespie.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. D. Y. N. Crosby; Sgt. A. N. Irving; P/O. G. A. G. Saunders; Sgt. R. L. Steadman; Sgt. S. L. Thompson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. A. Jones.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. L. C. Bentley; Sgt. D. S. Fisk; Sgt. J. C. Hill; Sgt. J. A. Jacques; Sgt. W. T. Shaver; Sgt. F. C. Stephenson; Sgt. F. W. Wade.

MISSING.—Sgt. I. A. M. Barber; Sgt. W. H. S. Byers; Sgt. D. J. Carmichael; P/O. D. M. Elliott; Sgt. J. F. Gauley; Sgt. G. J. Goodwin; Sgt. H. W. McColn; P/O. H. L. Myers; P/O. G. C. O'Neill; Sgt. T. E. Parker; P/O. H. H. Pibus; Sgt. D. Schafheitlin; Sgt. B. W. Shelnutt.

KILLED ON ACTIVE SERVICE.—P/O. C. W. Rush; Sgt. R. F. Leighton; Sgt. R. T. Oliver; P/O. C. R. B. Weidenfeller.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. K. A. Hepburn; Sgt. H. F. Rochford.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. A. Grady.

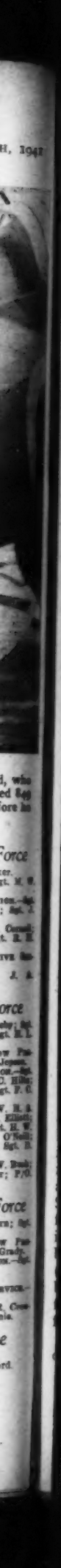
MISSING, BELIEVED KILLED IN ACTION.—Sgt. F. E. Spark.

MISSING.—Sgt. P. F. M. Cooke.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. R. S. G. Thornton.

KILLED ON ACTIVE SERVICE.—Sgt. W. R. Crowther; Sgt. H. Roughton; P/O. L. T. Young.

South African Air Force

MISSING.—Lt. D. H. Blair.

DIED ON ACTIVE SERVICE.—A/M. T. Ford.